ORIGINS OF SOCKEYE SALMON IN 1993 EASTSIDE BRISTOL BAY FISHERIES BASED ON LINEAR DISCRIMINANT FUNCTION ANALYSIS OF SCALE PATTERNS

By

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ABSTRACT

Stock composition of the 1993 commercial sockeye salmon *Oncorhynchus nerka* harvests in Naknek-Kvichak, Egegik, and Ugashik Districts, Bristol Bay, Alaska, were estimated with scale pattern analyses and age composition. Scale measurements from age-2.2 and -2.3 sockeye salmon escapement samples were used to build discriminant functions which allowed the stock composition of these age groups in the commercial catch to be estimated. Stock origins for other age groups were estimated by combining age-2.2 and -2.3 scale pattern analyses with escapement age compositions. Most sockeye salmon harvested had originated from rivers within the fishing district; however, harvest of outside stocks occurred in every district. Of the estimated 8,907,876 sockeye salmon caught in Naknek-Kvichak District, 44.3% were from Kvichak River, 41.8% from Naknek River, 9.0% from Egegik River, and 4.9% from Ugashik River. The estimated 21,600,858 sockeye salmon caught in Egegik District were composed of the following stocks: 87.5% Egegik, 7.3% Ugashik, 3.8% Naknek, and 1.4% Kvichak Rivers. The estimated Ugashik District harvest of 4,176,900 sockeye salmon was 63.3% Ugashik River, 24.0% Naknek River, 12.5% Egegik River, and 0.2% Kvichak River origin. Estimated exploitation rates were 93.0% for Egegik River, 78.3% for Naknek River, 77.0% for Ugashik River, and 51.5% for Kvichak River stocks.

KEY WORDS: Sockeye salmon *Oncorhynchus nerka*, Bristol Bay, scale pattern analysis, linear discriminant analysis, stock composition, exploitation rate

INTRODUCTION

To facilitate discrete stock management, the Bristol Bay sockeye salmon *Oncorhynchus nerka* fishery is restricted to districts located near the mouths of major spawning streams (Figure 1). However, the close proximity of thes spawning streams and annual variation in migratory routes causes stock mixing in the fisheries.

The Bristol Bay Management Area is divided into two general fisheries, the East and West Side. The Eastside fishery is composed of Naknek-Kvichak, Egegik, and Ugashik Districts (Figure 1); the Westside fishery includes Nushagak and Togiak Districts. Naknek-Kvichak District is subdivided into Naknek and Kvichak Sections.

From 1956 to present, stock composition estimates from Naknek-Kvichak District harvests have been based on escapement age composition estimates from Kvichak, Alagnak (Branch), and Naknek Rivers. Total runs of sockeye salmon to Egegik and Ugashik Rivers were estimated by adding the district catch to the district escapement. This standard method assumes (1) that all fish harvested in a district were returning to rivers within that district, and (2) equal exploitation among stocks. Complete results of the standard method have been summarized and published in separate reports (Stratton 1991; Stratton and Crawford 1992); Stratton and Crawford (1994). Bernard (1983) evaluated the biases inherent with this procedure.

More recently a second method based on linear discriminant function analysis of scale patterns has been used as well as the standard method. Use of this method began when decreased catches of sockeye salmon in Naknek-Kvichak District in 1985 and 1986 prompted concerns that these fish were being intercepted in Egegik and Ugashik Districts where catches were large (Figure 2). Straty (1975), after conducting a tagging study from 1955 to 1957, concluded that Eastside sockeye salmon stocks mixed in all Eastside districts and that Westside stocks were not present in appreciable numbers in Eastside districts. Examining the 1985 Eastside commercial catches, Fried and Yuen (1985) found that scale pattern analysis could accurately identify major Eastside sockeye salmon stocks. Scale pattern studies were expanded and stock compositions of Eastside district catches were recently estimated by Burns (1991) for the 1983 and 1984 runs; estimates for 1986 to 1992 have also been completed (Bue et al. 1986; Cross and Stratton 1989; Cross and Stratton 1991; Cross et al. 1992; Stratton et al. 1992; Stratton and Miller 1993; Stratton and Miller 1994).

Objectives of this ongoing investigation of Eastside sockeye salmon runs include (1) estimation of stock composition in Eastside commercial sockeye salmon harvests; (2) estimation of total run by river; and (3) comparison of run estimates by river as obtained from scale pattern analyses versus the standard method. For this report, the objectives were specific to the 1993 run.

METHODS

Catch and Escapement Estimation

Commercial catch statistics are final and were taken from fish ticket summaries produced by Computer Services. Sockeye salmon escapement estimates were based on visual counts made from towers on the banks of Kvichak, Naknek, Egegik, and Ugashik Rivers (ADF&G 1994).

Age Composition Estimation

European notation (Koo 1962) was used to record ages; numerals preceding the decimal refer to number of freshwater annuli, numerals following the decimal refer to number of marine annuli. Total age from time of egg deposition (brood year) is the sum of these numbers plus one. Complete methods and results of sampling Bristol Bay sockeye salmon catches and escapements have been summarized and published in separate reports (Stratton 1991; Stratton and Crawford 1992; Stratton and Crawford 1994). The 1993 sampling efforts will be similarly reported.

Catch Composition Estimation

Linear discriminant function analysis (Fisher 1936) of scale patterns combined with age composition data were used to determine sockeye salmon stock origins in 1993 Eastside harvests.

Scale Measurements

Scale impressions were projected at 100X magnification onto a digitizing tablet using equipment similar to that described by Ryan and Christie (1976). Measurements were taken along the anterior-posterior axis to standardize each scale. This axis is approximately 20° ventral of the long axis and perpendicular to the anterior sculptured field (Figure 3). Distances between growth rings, or circuli, were measured to the nearest 0.01 in, and number of circuli were counted from (1) center of scale focus to outside edge of first

freshwater annulus (first freshwater annular zone), (2) outside edge of first freshwater annulus to outside edge of second freshwater annulus (second freshwater annular zone), (3) outside edge of last freshwater annulus to end of freshwater growth (freshwater plus growth zone), if present, and (4) outside edge of last freshwater circulus to outer edge of first ocean annulus (first marine annular zone). Total distance from the outside edge of first ocean annulus to outside edge of second ocean annulus (second marine annular zone) was recorded for age-2.3 sockeye salmon. A total of 108 variables for age-2.2 samples and 109 variables for age-2.3 samples were computed from distance measurements and circuli counts (Appendix A.1).

Linear Discriminant Analysis

Escapement samples from Kvichak, Naknek, Egegik, and Ugashik Rivers provided known-origin scales to build linear discriminant functions (LDF). Commercial catch samples provided scales of unknown origin. Escapement samples collected in 1993 were used to classify 1993 commercial catches in age-specific LDF models.

Frequency distribution plots for principal scale variables for each growth zone were examined. Scale variable selection for each discriminant model was made using a forward stepping procedure with partial *F*-statistics as criteria for entry or removal of variables (Enslein et al. 1977). This process was continued until model accuracy ceased improving. The equality of variance-covariance matrices were tested using an *F*-statistic described by Box (1949). A nearly unbiased estimate of overall classification accuracy for each LDF was determined with a "leaving-one-out procedure" (Lachenbruch 1967).

Construction of Age-2.2 Models. A four-way linear discriminant model was built from scale measurements of age-2.2 sockeye salmon entering Kvichak, Naknek, Egegik, and Ugashik Rivers. Scale samples weighted by run strength through time were used to build the discriminant models.

Classification of Age-2.2 Sockeye Salmon. The four-way linear discriminant model was used to assign unknown age-2.2 samples to river of origin. Stock proportions in the catches estimated from the model were adjusted for misclassification error with the procedure of Cook and Lord (1978). The adjusted proportions were assumed to reflect true stock composition. A catch sample was reclassified with a model containing fewer stocks if the adjusted proportion ≤ 0 for one or more stocks in the four-way model. Variance and 90% confidence intervals around adjusted estimates were computed using the procedure of Pella and Robertson (1979).

The number of age-2.2 sockeye salmon for stock *i* in a specific catch stratum, ($\hat{C}_{i2.2}$) was

calculated as

$$\hat{C}_{i2.2}=\hat{C}\hat{P}_{2.2}\hat{S}_{i2.2}, \quad (1)$$

where:

$\hat{C}$ = estimated catch of sockeye salmon in a fishery at a given time,

$\hat{P}_{2.2}$ = estimated proportion of age-2.2 sockeye salmon in the catch, and

$\hat{S}_{i2.2}$ = estimated proportion of age-2.2 sockeye salmon of stock *i* in the catch.

In this procedure, the variance about catch ($\hat{C}$) is not evaluated. Consequently, a conditional variance of the estimated age-2.2 sockeye salmon catch ($V[\hat{C}_{i2.2}]$) for each stock in a specific fishery at a given time was calculated as described by Goodman (1960). This provided an exact variance of a product conditional on catch:

$$V[\hat{C}_{i2.2}] = C^2 V[\hat{P}_{2.2}\hat{S}_{i2.2}], \quad (2)$$

$$V[\hat{P}_{2.2}\hat{S}_{i2.2}] = V[\hat{P}_{2.2}]\,\hat{S}^2_{i2.2} + V[\hat{S}_{i2.2}]\,\hat{P}^2_{2.2} - V[\hat{S}_{i2.2}]\,V[\hat{P}_{2.2}]. \quad (3)$$

Contributions for each stock through time for a specific fishery were added to estimate total contribution to that fishery. The variance of the total contribution was calculated by summing the variances for each period. The contributions by stock to each fishery were added to produce the total contribution by stock to the Eastside age-2.2 sockeye salmon harvest. The variance of the total contribution by stock was calculated as the sum of the variances for each fishery.

Construction of Age-2.3 Models. A four-way linear discriminant model was built from scale measurements of age-2.3 sockeye salmon entering Kvichak, Naknek, Egegik, and Ugashik Rivers. Scale samples weighted by run strength through time were used to build the discriminant models. Frequency distribution plots of the total size of all freshwater growth zones for Kvichak, Naknek, and Ugashik River stocks were similar (Figure 4). Therefore, all Kvichak, Naknek, and Ugashik River samples were pooled. A two-way linear discriminant model was built using scales from Egegik and Kvichak/Naknek/Ugashik Rivers pooled.

Classification of Age-2.3 Sockeye Salmon. The two-way age-2.3 model was used to classify catches that were estimated to contain a large component of age-2.2 Egegik River stocks. These included catches on and before July 9 in Naknek-Kvichak District and all catches in Egegik District. Procedures for the age-2.3 analysis were the same as those used for the age-2.2 analysis.

Separation of Kvichak/Naknek/Ugashik Age-2.3 Catch

The age-2.3 sockeye salmon catch proportion classified to the Kvichak/Naknek/Ugashik group was separated to each river ($\hat{S}_{i2.3}$) based on age composition of the escapements:

$$\hat{S}_{i2.3} = \hat{S}_{p2.3} \frac{\hat{E}_{i2.3}}{\hat{E}_{p2.3}}, \tag{4}$$

where:

$\hat{S}_{p2.3}$ = estimated proportion of age-2.3 sockeye salmon of Kvichak/Naknek/Ugashik pooled stocks in the catch,

$\hat{E}_{i2.3}$ = estimated number of age-2.3 sockeye salmon in stock *i* escapement, and

$\hat{E}_{p2.3}$ = estimated number of age-2.3 sockeye salmon in Kvichak, Naknek, and Ugashik River pooled escapement.

Other Age Group Stock Composition Estimation

Estimates of stock composition for sockeye salmon of other ages harvested in Naknek-Kvichak District on and before July 9 and in Egegik District were based on scale pattern estimates for age-2.2 and -2.3 sockeye salmon, and the ratio of age-2.2 and -2.3 sockeye salmon to sockeye salmon of other age groups within the respective escapements:

$$\hat{S}_{ij} = \frac{\hat{S}_{i(2.2,2.3)} \frac{\hat{T}_{ij}}{\hat{T}_{i(2.2,2.3)}}}{\sum_{i=1}^{n} \left(\hat{S}_{i(2.2,2.3)} \frac{\hat{T}_{ij}}{\hat{T}_{i(2.2,2.3)}} \right)}, \tag{5}$$

where:

$\hat{T}_{ij}$ = estimated proportion of age *j* sockeye salmon in stock *i* escapement,

$$\hat{S}_{i(2.2,2.3)} = \frac{\hat{C}_{i2.2} + \hat{C}_{i2.3}}{\hat{C}_{2.2} + \hat{C}_{2.3}}, \quad (6)$$

$$\hat{T}_{i(2.2,2.3)} = \frac{\hat{E}_{i2.2} + \hat{E}_{i2.3}}{\hat{E}_i}. \quad (7)$$

$\hat{T}_{i(2.2,2.3)}$ = estimated proportion of combined age-2.2 and age-2.3 sockeye salmon in stock *i* escapement,

$\hat{S}_{i(2.2,2.3)}$ = estimated proportion of combined age-2.2 and age-2.3 sockeye salmon of stock *i* in the catch,

$\hat{C}_{i2.2}$ = estimated number of age-2.2 sockeye salmon of stock *i* in the catch,

$\hat{C}_{i2.3}$ = estimated number of age-2.3 sockeye salmon of stock *i* in the catch,

$\hat{C}_{2.2}$ = estimated number of age-2.2 sockeye salmon in the catch,

$\hat{C}_{2.3}$ = estimated number of age-2.3 sockeye salmon in the catch,

$\hat{E}_{i2.2}$ = estimated number of age-2.2 sockeye salmon in stock *i* escapement,

$\hat{E}_{i2.3}$ = estimated number of age-2.3 sockeye salmon in stock *i* escapement, and

$\hat{E}_i$ = estimated number of stock *i* escapement.

Estimates of stock composition for sockeye salmon of other ages harvested in Naknek-Kvichak District after July 9 and in Ugashik District were based on scale pattern estimates for age-2.2 sockeye salmon, and the ratio of age-2.2 sockeye salmon to sockeye salmon of other age groups within the respective escapements:

$$\hat{S}_{ij} = \frac{\hat{S}_{i2.2}\frac{\hat{T}_{ij}}{\hat{T}_{i2.2}}}{\sum_{i=1}^{n}\left(\hat{S}_{i2.2}\frac{\hat{T}_{ij}}{\hat{T}_{i2.2}}\right)}, \quad (8)$$

where:

$\hat{T}_{ij}$ = estimated proportion of age *j* sockeye salmon in stock *i* escapement,

$$\hat{S}_{i2.2} = \frac{\hat{C}_{i2.2}}{\hat{C}_{2.2}}, \quad (9)$$

$$\hat{T}_{i2.2} = \frac{\hat{E}_{i2.2}}{\hat{E}_i}. \quad (10)$$

$\hat{T}_{i2.2}$ = estimated proportion of age-2.2 sockeye salmon of stock *i* in the escapement,

$\hat{S}_{i2.2}$ = estimated proportion of age-2.2 sockeye salmon of stock *i* in the catch,

$\hat{C}_{i2.2}$ = estimated number of age-2.2 sockeye salmon of stock *i* in the catch,

$\hat{C}_{2.2}$ = estimated number of age-2.2 sockeye salmon in the catch,

$\hat{E}_{i2.2}$ = estimated number of age-2.2 sockeye salmon in stock *i* escapement,

$\hat{E}_i$ = estimated number of stock *i* escapement.

Run Size Estimation

Sockeye salmon run size to each river was estimated by adding estimates of catch by stock to escapement estimates. For each river, we computed the percentage (1) harvested within the natal district, (2) harvested outside the natal district, and (3) that escaped. Finally, run size estimates from scale pattern analysis were compared with estimates from the standard method.

RESULTS

Catch and Escapement

Eastside commercial fishermen harvested an estimated 34,685,634 sockeye salmon in 1993 (Table 1). This was 59% greater than the 1983-92 average catch of 20.5 million. The 21,600,858 sockeye salmon caught in Egegik District accounted for 62.3% of the Eastside harvest; commercial harvests in Naknek-Kvichak were 8,907,876 or 25.7% of the Eastside harvest and in Ugashik were 4,176,900 or 12.0%.

Sockeye salmon escapements in 1993 were estimated to be 4,025,166 in Kvichak River, 1,535,658 in Naknek River, 1,516,980 in Egegik River, and 1,389,534 in Ugashik River (Table 2).

Age Composition

Four age groups made up 98.6% of the Eastside sockeye salmon catch: age-1.2 was 6.5%, age-1.3 was 10.1%, age-2.2 was 40.1%, and age-2.3 was 41.9% (Table 3). Naknek-Kvichak District catch was 31.1% age-2.3, 30.3% age-2.2, and 21.6% age-1.3. Egegik District catch was 46.5% age-2.3 and 44.6% age-2.2. Ugashik District catch was 40.9% age-2.3 and 38.6% age-2.2.

Age composition of sockeye salmon escapements also varied among runs (Table 4). Kvichak River escapement was 44.1% age-2.2, 24.2% age-1.3, and 22.6% age-1.2 sockeye salmon. Naknek River escapement was 56.5% age-2.3 and 20.2% age-1.3. Egegik River escapement was 49.5% age-2.3 and 40.8% age-2.2. Ugashik River escapement was 36.3% age-2.3, 26.7% age-2.2, and 20.4% age-1.2.

Classification Models

Age 2.2

Scale characteristics which differed the most among age-2.2 sockeye salmon stocks were variables 64, 27, and 36 (Tables 5, 6; Figure 5). In general, freshwater growth was greatest in Egegik River, followed by Kvichak, Naknek, and Ugashik Rivers.

Estimated overall classification accuracy for the four-way model was 70.1% (Table 6). Individual classification accuracy was highest for Ugashik River (74.6%), followed by Egegik (72.5%), Kvichak (68.2%), and Naknek (65.1%) River. The range of overall classification accuracies were 73.1% to 80.0% for three-way models, while the two-way model had an overall classification accuracy of 95.0%.

Age 2.3

Scale variables were similar between Kvichak, Naknek, and Ugashik samples; the four-way

model could not accurately differentiate between these stocks (Tables 7, 8; Figure 4). Egegik stocks were distinct (Figure 6). Therefore, Kvichak, Naknek, and Ugashik samples were pooled and compared to Egegik River samples in a two-way model. Scale measurements that provided the greatest discrimination among age-2.3 sockeye salmon in the two-way model were variables 65, 57, and 63 (Tables 7, 8).

Estimated overall classification accuracy for the two-way model was 85.5% (Table 8). Individual classification accuracies were equal for Egegik and Kvichak/Naknek/Ugashik combined (85.5%)

Estimates of Catch Composition

Age 2.2

Of the estimated 2,700,419 age-2.2 sockeye salmon caught in Naknek-Kvichak District, 80.3% originated within the district and 19.7% from outside the district (Figure 7). Of the estimated 9,629,905 age-2.2 sockeye salmon caught in Egegik District, 87.7% originated from Egegik River and 12.3% were produced outside the district (Figure 8). The estimated catch of age-2.2 sockeye salmon in Ugashik District was 1,609,938; 68.5% originated in Ugashik River and 31.5% from outside the district (Figure 9). The 90% confidence intervals by group are presented in Tables 9 and 10.

Age 2.3

Of the estimated 2,772,120 age-2.3 sockeye salmon caught in Naknek-Kvichak District, 82.7% originated within the district and 17.3% from outside the district (Figure 10). Of the estimated 10,051,082 age-2.3 sockeye salmon caught in Egegik District, 92.6% originated from Egegik River and 7.4% were produced outside the district (Figure 11). The estimated catch of age-2.3 sockeye salmon in Ugashik District was 1,709,640; 54.7% originated in Ugashik River and 45.3% from stocks outside the district (Figure 12). The 90% confidence intervals by group for Naknek/Kvichak District through July 9 and Egegik District are presented in Tables 11 and 12.

All Ages

The Naknek-Kvichak District harvest was composed of an estimated 3,949,371 sockeye

salmon from Kvichak River, 3,720,655 from Naknek River, 801,900 from Egegik River, and 435,950 from Ugashik River (Table 13). Estimated stock contributions to the Naknek-Kvichak District total catch were 44.3% for Kvichak, 41.8% for Naknek, 9.0% for Egegik, and 4.9% for Ugashik Rivers (Figure 13).

Of the sockeye salmon caught in Egegik District, an estimated 18,912,281 were from Egegik River, 1,568,619 from Ugashik River, 812,284 from Naknek River, and 307,674 from Kvichak River (Table 14). Estimated stock contributions to the Egegik District total catch were 87.6% Egegik, 7.3% Ugashik, 3.8% Naknek, and 1.4% Kvichak Rivers (Figure 14).

The Ugashik District catch was composed of an estimated 2,642,166 sockeye salmon from Ugashik River, 1,002,942 from Naknek River, 521,475 from Egegik River, and 10,317 from Kvichak River (Table 15). Estimated stock contribution to the total Ugashik District sockeye salmon catch were 63.3% from Ugashik River, 24.0% from Naknek River, 12.5% from Egegik River, and 0.2% from Kvichak River (Figure 15).

Harvest Distribution

Of the estimated 4,267,362 Kvichak River sockeye salmon harvested in 1993, 92.6% were taken in Naknek-Kvichak, 7.2% in Egegik, and 0.2% in Ugashik Districts (Table 16). Of the estimated 5,535,881 Naknek River sockeye salmon harvested, 67.2% were taken in Naknek-Kvichak, 18.1% in Ugashik, and 14.7% in Egegik Districts. Of the estimated 20,235,656 Egegik River sockeye salmon harvested, 93.5% were taken in Egegik, 4.0% in Naknek-Kvichak, and 2.6% in Ugashik Districts. Of the estimated 4,646,735 Ugashik River sockeye salmon harvested, 56.9% were taken in Ugashik, 33.8% in Egegik, and 9.4% in Naknek-Kvichak Districts.

An estimated 2,133,217 sockeye salmon destined for Kvichak and Naknek Rivers were harvested outside their natal district, whereas Naknek-Kvichak District fishermen caught 1,237,850 sockeye salmon bound for other districts. Therefore, Naknek-Kvichak District fishermen realized a net loss of 895,367 sockeye salmon. The number of Egegik River sockeye salmon harvested in other districts was 1,323,375, whereas fishermen in Egegik District caught 2,688,577 sockeye salmon bound for other districts. Therefore, Egegik District fishermen realized a net gain of 1,365,202 sockeye salmon. An estimated 2,004,569 Ugashik River sockeye salmon were harvested outside Ugashik District, whereas 1,534,734 sockeye salmon from other rivers were caught in Ugashik District. Therefore, Ugashik District fishermen had a net loss of 469,835 sockeye salmon.

Run By River System

Run Distribution

The 1993 Kvichak River run was estimated to be 8,292,528 sockeye salmon: 48.6% escaped, 47.6% were harvested in Naknek-Kvichak District, and 3.8% were harvested in other districts (Tables 17, 18; Figure 16). The 1993 Naknek River run was estimated to be 7,071,539 sockeye salmon: 21.7% escaped, 52.6% were harvested in Naknek-Kvichak District, and 25.7% were harvested in other districts (Figure 17). The 1993 Egegik River run was estimated to be 21,752,636 sockeye salmon: 7.0% escaped, 86.9% were harvested in Egegik District, and 6.1% were harvested in other districts (Figure 18). The 1993 Ugashik River run was estimated to be 6,036,269: 23.0% escaped, 43.8% were harvested in Ugashik District, and 33.2% were harvested in other districts (Figure 19).

Exploitation Rates

The Ugashik River run was exploited outside the natal district at a 33.2% rate, slightly higher than Naknek River's run (25.7%). Egegik (6.1%) and Kvichak (3.8%) Rivers were exploited outside their natal district at much lower rates. Total exploitation rates based on harvests inside and outside the natal district were 51.5% for Kvichak River, 77.0% for Ugashik River, 78.3% for Naknek River, and 93.0% for Egegik River (Tables 17, 18; Figures 16-19).

Comparison of Run Estimates

Run estimates based on the standard method cannot be directly compared to those based on scale pattern analysis because Branch River stock was not included in linear discriminant models. Therefore, standard run estimates were adjusted so that Naknek-Kvichak District catch was only divided between Kvichak and Naknek Rivers. Naknek River had the greatest difference in estimated run size between the two methods (Table 19). The standard method estimate for the Naknek River run was 2,299,711 sockeye salmon less than that obtained from scale pattern analysis. Estimates for Egegik River differed by 1,408,179, the standard method estimate being higher. Estimates for Kvichak River differed by 1,289,277, the standard method estimate again being higher. The standard method estimate of run size for Ugashik River was 397,745 lower than that obtained from scale pattern analysis. Harvests of stocks outside their natal districts in 1993 resulted in the standard method over-estimating runs to Kvichak (13.5%) and Egegik Rivers (6.1%) and under-estimating runs to Naknek (-48.2%) and Ugashik (-7.1%) Rivers.

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Table 1. Sockeye salmon commercial catch by district and date for the Eastside of Bristol Bay, 1993.

Date	Catch by District			
	Naknek-Kvichak	Egegik	Ugashik	Total
6/02-6/11	60	[a]	325	385
6/14-6/18	44,431	186[b]	27,263	71,880
6/19		94[b]		94
6/20		527,865		527,865
6/21	280,565	327,067	17,165	624,797
6/22	357,515	761,534	49,046	1,168,095
6/23	147,897		14,064	161,961
6/24		917,581	249[b]	917,830
6/25	75,283	1,126,966	879[b]	1,203,128
6/26	352,596	1,254,426	679[b]	1,607,701
6/27	452,388	899,989	351[b]	1,352,728
6/28	658,674	1,389,528	404[b]	2,048,606
6/29	461,921	1,059,168	531[b]	1,521,620
6/30	514,692	762,165	73,616	1,350,473
7/01	532,866	855,430	1,664[b]	1,389,960
7/02	1,915,623	2,703,970	983[b]	4,620,576
7/03		1,914,630	275,315	2,189,945
7/04	585,599	1,196,757	681[b]	1,783,037
7/05	525,117	1,093,049	275,017	1,893,183
7/06	331,728	965,146	402,789	1,699,663
7/07	496,094	935,691	498,764	1,930,549
7/08	280,640	757,079	698,546	1,736,265
7/09	296,008	596,558	427,669	1,320,235
7/10	116,256	384,853	365,465	866,574
7/11	163,577	250,188	244,447	658,212
7/12	73,412	208,862	204,148	486,422
7/13	113,814	142,150	123,789	379,753
7/14	52,525	132,723	131,700	316,948
7/15		88,506	95,791	184,297
7/16	14,491	57,335	58,347	130,173
7/17	8,362	54,372	14,959	77,693
7/18	7,464	69,095		76,559
7/19	8,856	48,861	37,252	94,969
7/20	12,068	46,198	28,139	86,405
7/21	8,582	15,652	33,046	57,280
7/22	7,248	20,685	27,096	55,029
7/23	2,463	5,417	5,390	13,270
7/26-7/30	8,032	25,063	33,816	66,911
8/02-8/06	1,029	4,264	6,516	11,809
8/09-8/13		1,473	829	2,302
8/16-9/08		282	170	452
Total	8,907,876	21,600,858	4,176,900	34,685,634
Percent	25.7	62.3	12.0	100.0

[a] Blanks indicate a district was closed.

[b] ADF&G test-fish catch

Table 3. Sockeye salmon age composition by brood year in the commercial catch for the Eastside of Bristol Bay, 1993.

District	Sample Size		1990	1989			1988		1987			1986		Total
			1.1	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	
Naknek-Kvichak	6,044	Numbers	3,953	5,481	1,408,428	1,780	1,921,848	2,700,419	57,994	2,772,120	5,970	23,819	6,064	8,907,876
		Percent	0.0[a]	0.1	15.8	0.0	21.6	30.3	0.6	31.1	0.1	0.3	0.1	100.0
Egegik	4,702	Numbers		6,141	467,614		1,149,266	9,629,905	86,283	10,051,083	106,349	75,104	29,114	21,600,858
		Percent		0.0	2.2		5.3	44.6	0.4	46.5	0.5	0.4	0.1	100.0
Ugashik	3,464	Numbers		4,810	363,966	2,347	446,722	1,609,938	19,937	1,709,640	9,061	10,479		4,176,900
		Percent		0.1	8.7	0.0	10.7	38.6	0.5	40.9	0.2	0.3		100.0
Total	14,210	Numbers	3,953	16,432	2,240,008	4,127	3,517,836	13,940,262	164,214	14,532,843	121,380	109,402	35,178	34,685,634
		Percent	0.0	0.0	6.5	0.0	10.1	40.1	0.5	41.9	0.4	0.4	0.1	100.0

[a] Represented <0.1%

Table 4. Sockeye salmon age composition by brood year in the escapement for the Eastside of Bristol Bay, 1993.

River	Sample Size		1990		1989			1988			1987			1986		Total
			0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	1.4	2.3	3.2	2.4	3.3	
Kvichak	3,244	Numbers	5,310	4,138	46,934	910,608	115,822	896	973,736	1,776,665	2,592	188,465				4,025,166
		Percent	0.1	0.1	1.2	22.6	2.9	0.0[a]	24.2	44.1	0.1	4.7				100.00
Naknek	2,479	Numbers				95,857	4,388		310,303	209,405	36,054	867,410		12,241		1,535,658
		Percent				6.2	0.3		20.2	13.6	2.4	56.5		0.8		100.00
Egegik	3,011	Numbers				14,832	33,519		72,584	618,346	10,392	752,404	9,308	3,093	2,502	1,516,980
		Percent				1.0	2.2		4.8	40.8	0.7	49.5	0.6	0.2	0.2	100.00
Ugashik	2,040	Numbers	185	1,112	1,482	284,029	11,521		211,738	370,434	3,366	502,283		3,384		1,389,534
		Percent	0.0	0.1	0.1	20.4	0.8		15.2	26.7	0.2	36.3		0.2		100.00

[a] Represented <0.1%

Table 5. Mean and standard error of age-2.2 scale variables used to construct linear discriminant functions for the Eastside of Bristol Bay, 1993.

Variable		Kvichak		Naknek		Egegik		Ugashik	
Number	Name	Mean[a]	SE	Mean	SE	Mean	SE	Mean	SE
First Freshwater Annular Zone									
5	CO-C6	99.07	0.617	89.67	0.696	99.75	0.537	84.56	0.546
8	C2-C6	48.14	0.399	43.28	0.452	49.07	0.390	38.86	0.334
10	C4-C6	22.19	0.249	19.50	0.237	22.62	0.215	17.69	0.191
12	C(NC-4)-E1FW	34.35	0.338	31.83	0.268	34.69	0.301	31.01	0.264
16	CO-C2/S1FW	0.41	0.005	0.39	0.005	0.34	0.004	0.43	0.004
21	C2-C6/S1FW	0.38	0.003	0.36	0.003	0.32	0.003	0.36	0.003
25	C(NC-4)-E1FW/S1FW	0.28	0.004	0.27	0.005	0.23	0.003	0.29	0.003
27	S1FW/NC1FW	13.63	0.088	12.21	0.073	13.05	0.067	11.90	0.074
28	NC 1ST 3/4	5.17	0.081	5.75	0.090	7.04	0.117	5.09	0.065
Second Freshwater Annular Zone									
36	E1FW-C8	91.78	0.557	84.07	0.629	94.16	0.540	92.15	0.608
42	C(NC-4)-E2FW	34.55	0.350	32.54	0.319	36.13	0.324	35.09	0.345
48	E1FW-C6/S2FW	0.70	0.005	0.68	0.007	0.64	0.006	0.70	0.005
51	C2-C6/S2FW	0.46	0.004	0.44	0.005	0.43	0.004	0.47	0.004
56	C(NC-4)-E2FW/S2FW	0.15	0.002	0.16	0.003	0.14	0.002	0.15	0.002
57	S2FW/NC2FW	10.78	0.064	9.94	0.065	10.97	0.060	10.84	0.066
Freshwater and Plus Growth Zones									
64	S1FW+S2FW	233.89	1.432	221.60	1.581	270.11	1.873	213.32	1.376
65	NC1+NC2+NCPG	23.39	0.127	21.65	0.133	23.50	0.131	20.79	0.107
66	S1F+S2F+SPGZ	245.49	1.425	239.19	1.498	281.55	1.732	235.53	1.251
67	S1FW/S1FW+S2FW+SPGZ	0.52	.004	0.51	0.005	0.55	0.004	0.46	0.003
First Marine Annular Zone									
80	C3-C15	273.74	1.241	273.62	1.423	264.19	1.304	268.53	1.186
82	C6-C12	139.43	0.806	139.90	0.950	133.58	0.859	135.84	0.755
84	C9-C15	128.17	0.775	130.47	0.951	120.42	0.732	128.37	0.713

[a] Scale images projected at 100x magnification and measured at 0.01 in; therefore, variable means are in 0.0001 in.

Table 6. (p 2 of 3).

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		Kvichak	Naknek	Ugashik
Kvichak	199	75.9	14.1	10.1
Naknek	173	15.6	65.3	19.1
Ugashik	200	10.5	11.5	78.0

Mean classification accuracy = 73.1%
Variables used: 5, 65, 64, 57, 82, 8, 27, 56, 10
Box's Test of Variance-Covariance Equality
F-statistic = 1.94
df = 90, 857,617
P = 0.000

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		Kvichak	Egegik	Ugashik
Kvichak	195	72.9	13.8	13.3
Egegik	200	16.0	80.0	4.0
Ugashik	197	11.7	1.0	87.3

Mean classification accuracy = 80.0%
Variables used: 64, 5, 36, 66, 27, 8, 84
Box's Test of Variance-Covariance Equality
F-statistic = 4.10
df = 56, 990,149
P = 0.000

-Continued-

Table 6. (p 3 of 3).

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		Naknek	Egegik	Ugashik
Naknek	169	73.3	8.9	17.8
Egegik	200	12.5	81.5	6.0
Ugashik	197	16.8	2.5	80.7

Mean classification accuracy = 78.5%
Variables used: 64, 36, 80, 21
Box's Test of Variance-Covariance Equality
F-statistic = 3.96
df = 20, 1,085,858
P = 0.002

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		Egegik	Ugashik
Egegik	200	94.5	5.5
Ugashik	197	4.6	95.4

Mean classification accuracy = 95.0%
Variables used: 36, 27, 16, 84, 48, 25, 12
Box's Test of Variance-Covariance Equality
F-statistic = 5.05
df = 28, 543,422
P = 0.000

[a] The equality of the variance-covariance matrices tested with a procedure described by Box (1949).

Table 7. Mean and standard error of age-2.3 scale variables used to construct linear discriminant functions for the Eastside of Bristol Bay, 1993.

Variable		Kvichak		Naknek		Egegik		Ugashik	
Number	Name	Mean[a]	SE	Mean	SE	Mean	SE	Mean	SE
First Freshwater Annular Zone									
2	S1FW	137.11	1.638	126.52	1.302	155.55	1.740	126.82	0.993
6	C0-C8	119.56	0.890	109.02	0.692	117.47	0.677	110.44	0.650
10	C4-C6	23.04	0.347	20.71	0.225	22.04	0.220	20.87	0.234
19	C0-C8/S1FW	0.88	0.007	0.86	0.005	0.77	0.007	0.87	0.004
27	S1FW/NC1FW	13.29	0.092	12.27	0.073	12.48	0.063	12.46	0.070
Second Freshwater Annular Zone									
35	E1FW-C6	70.67	0.829	63.54	0.441	70.41	0.449	73.30	0.490
40	C4-C6	21.63	0.439	19.63	0.243	23.03	0.229	21.88	0.237
41	C4-C8	39.25	0.710	37.31	0.388	43.42	0.388	38.93	0.372
56	(C(NC-2)-E2FW)/S2FW	0.16	0.004	0.16	0.003	0.15	0.002	0.16	0.002
57	S2FW/NC2FW	10.54	0.117	9.66	0.059	10.64	0.060	10.79	0.073
Freshwater and Plus Growth Zones									
63	NC1+NC2	19.45	0.164	19.98	0.129	22.68	0.123	19.72	0.108
65	NC1+NC2+NCPG	20.48	0.165	21.12	0.117	23.82	0.114	20.96	0.110
66	S1FW+S2FW+SPGZ	243.44	2.208	231.45	1.411	275.61	1.507	242.57	1.353
First Marine Annular Zone									
105	S1OZ/NC1OZ	18.32	0.122	18.69	0.090	18.22	0.088	18.37	0.078
Marine Zones Combined									
109	S2OZ	299.80	4.875	301.23	3.015	279.62	2.786	299.26	2.891

[a] Scale images projected at 100x magnification and measured at 0.01 in; therefore, variable means are in 0.0001 in.

Table 8. Classification matrices from discriminant analyses of age-2.3 sockeye salmon sampled from Kvichak, Naknek, Egegik, and Ugashik Rivers, 1993.

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)			
		Kvichak	Naknek	Egegik	Ugashik
Kvichak	80	56.3	18.8	6.3	18.8
Naknek	182	12.6	64.3	6.0	17.0
Egegik	194	8.8	8.2	74.2	8.8
Ugashik	194	19.6	18.0	4.6	57.7

Mean classification accuracy = 63.1%
Variables used: 66, 35, 6, 105, 41, 2, 19, 109, 56
Box's Test of Variance-Covariance Equality[a]
F-statistic = 6.70
df = 135, 352,864
P = 0.009

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		Kvichak/Naknek/Ugashik[b]	Egegik
Kvichak/Naknek/Ugashik	276	85.5	14.5
Egegik	200	14.5	85.5

Mean classification accuracy = 85.5%
Variables used: 65, 57, 63, 109, 27, 10, 35, 40
Box's Test of Variance-Covariance Equality
F-statistic = 2.52
df = 36, 619,906
P = 0.000

[a] The equality of the variance-covariance matrices tested with a procedure described by Box (1949).

[b] Kvichak, Naknek, and Ugashik Rivers combined.

Table 9. Run composition estimates and 90% confidence intervals (C.I.) calculated from scale pattern analyses of age-2.2 sockeye salmon by fishery and date for the Eastside of Bristol Bay, 1993.

		Kvichak		Naknek		Egegik		Ugashik	
District	Date	Percent	90% C.I.	Percent	90% C.I.	Percent	90% C.I.	Percent	90% C.I.
Naknek-	6/09-6/23	72.2	(50.7,93.7)	1.9	(0.0,16.7)	25.9	(8.8,43.0)	0.0	Trace[a]
Kvichak	6/24-6/26	37.0	(17.7,56.3)	5.0	(0.0,18.3)	58.0	(39.9,76.0)	0.0	Trace
	6/27	62.8	(31.4,94.4)	28.9	(0.0,58.6)	2.7	(0.0,19.9)	5.6	(0.0,25.0)
	6/28-6/29	76.5	(49.3,100)	11.6	(0.0,33.8)	7.4	(0.0,24.0)	4.5	(0.0,19.6)
	6/30-7/01	56.5	(31.0,81.9)	18.7	(0.0,40.4)	20.1	(2.1,38.1)	4.7	(0.0,19.1)
	7/02	72.1	(51.9,92.2)	21.1	(4.2,38.1)	6.8	(0.0,19.6)	0.0	Trace
	7/04-7/05	48.2	(24.5,71.8)	24.5	(2.5,46.5)	11.4	(0.0,26.4)	15.9	(0.0,32.8)
	7/06-7/07	44.8	(20.4,69.3)	29.3	(6.2,52.4)	20.7	(2.9,38.4)	5.2	(0.0,20.1)
	7/08-7/09	56.0	(31.4,80.5)	25.0	(2.7,47.4)	12.0	(0.0,27.8)	7.0	(0.0,22.1)
	7/10-7/11	51.5	(27.4,75.8)	36.2	(12.4,59.9)	11.4	(0.0,27.1)	0.9	(0.0,15.0)
	7/12-7/14	39.0	(15.9,62.1)	48.0	(23.1,72.8)	12.0	(0.0,27.6)	1.0	(0.0,16.0)
	7/16-8/06	1.2	(0.0,18.0)	84.7	(58.6,100)	0.0	Trace	14.1	(0.0,34.5)
Egegik	6/17-6/21	15.6	(0.0,34.1)	0.0	Trace	83.3	(66.0,100)	1.1	(0.0,9.7)
	6/22-6/24	0.0	Trace	0.0	Trace	95.3	(88.6,100)	4.7	(0.0,11.4)
	6/25-6/27	2.6	(0.0,18.7)	8.7	(0.0,22.1)	88.7	(70.9,100)	0.0	Trace
	6/28-6/29	0.0	Trace	0.0	Trace	100.0	(89.6,100)	0.0	Trace
	6/30-7/03	1.1	(0.0,22.0)	0.9	(0.0,15.6)	87.8	(65.9,100)	10.2	(0.0,23.2)
	7/04-7/06	0.0	Trace	0.0	Trace	79.4	(71.2,87.6)	20.6	(12.4,28.8)
	7/07-7/08	0.0	Trace	5.4	(0.0,20.6)	90.1	(75.5,100)	4.5	(0.0,14.9)
	7/09-7/11	9.2	(0.0,26.4)	0.0	Trace	79.3	(62.5,96.0)	11.5	(0.8,22.2)
	7/12-8/26	0.0	Trace	5.2	(0.0,20.4)	87.6	(72.8,100)	7.2	(0.0,18.2)
Ugashik	6/09-6/30	0.0	Trace	8.2	(0.0,23.9)	52.4	(37.7,67.2)	39.4	(23.6,55.1)
	7/01-7/06	0.0	Trace	21.1	(3.0,39.2)	16.6	(5.7,27.6)	62.3	(44.8,79.8)
	7/07-7/08	0.0	Trace	14.0	(0.0,31.5)	17.2	(6.3,28.1)	68.8	(51.3,86.1)
	7/09	0.0	Trace	18.6	(0.3,37.0)	8.0	(0.0,16.9)	73.4	(55.7,91.0)
	7/10-7/12	0.0	Trace	12.4	(0.0,29.9)	20.9	(9.1,32.6)	66.7	(49.1,84.3)
	7/13-8/17	3.3	(0.0,23.1)	4.9	(0.0,26.9)	11.2	(0.0,24.3)	80.6	(55.7,100)

[a] Trace was recorded for systems that were originally included in the model used to classify the catch, the point estimates were zero, and the upper bounds of the 90% C.I. were greater than zero.

Table 10. Estimated harvest of age-2.2 sockeye salmon and 90% confidence intervals (C.I.), Eastside of Bristol Bay, 1993.

District	River	Percent	Number	Standard Error	90% C.I. Lower	90% C.I. Upper
Naknek-Kvichak	Kvichak	59.9	1,616,649	103,848	1,393,491	1,839,435
	Naknek	20.4	551,715	82,023	375,531	727,753
	Egegik	14.9	402,885	63,837	265,786	539,916
	Ugashik	4.8	129,170	45,870	30,664	227,639
	Total	100.0	2,700,419			
Egegik	Kvichak	1.8	173,067	262,251	0	736,140
	Naknek	2.2	209,637	198,483	0	635,805
	Egegik	87.7	8,448,201	349,904	7,696,860	9,199,412
	Ugashik	8.3	799,001	181,324	409,679	1,188,319
	Total	100.0	9,629,905			
Ugashik	Kvichak	0.5	7,169	17,211	0	44,123
	Naknek	14.2	228,835	60,702	98,495	359,161
	Egegik	16.8	271,133	37,941	189,669	352,594
	Ugashik	68.5	1,102,800	65,580	961,975	1,243,588
	Total	100.0	1,609,938			
Total Eastside	Kvichak	12.9	1,796,885	282,064	1,191,077	2,402,313
	Naknek	7.1	990,187	217,437	523,254	1,456,970
	Egegik	65.4	9,122,219	354,922	8,360,068	9,884,169
	Ugashik	14.6	2,030,971	192,390	1,617,853	2,444,010
	Total	100.0	13,940,262			

Table 11. Run composition estimates and 90% confidence intervals (C.I.) calculated from scale pattern analyses of age-2.3 sockeye salmon by fishery and date, Naknek-Kvichak and Egegik Districts, 1993.

		Kvichak/Naknek/Ugashik[a]		Egegik	
District	Date	Percent	90% C.I.	Percent	90% C.I.
Naknek-Kvichak	6/09-6/23	73.5	(61.8,85.1)	26.5	(14.9,38.2)
	6/24-6/26	67.8	(55.9,79.7)	32.2	(20.3,44.1)
	6/27	100.0	(92.8,100)	0.0	Trace[b]
	6/28-6/29	92.3	(81.9,100)	7.7	(0.0,18.1)
	6/30-7/01	69.0	(53.0,84.9)	31.0	(15.1,47.0)
	7/02	100.0	(95.0,100)	0.0	Trace
	7/04-7/05	89.4	(78.9,100)	10.6	(0.0,21.1)
	7/06-7/07	95.1	(85.0,100)	4.9	(0.0,15.0)
	7/08-7/09	96.5	(86.6,100)	3.5	(0.0,13.4)
Egegik	6/17-6/21	12.0	(1.0,23.0)	88.0	(77.0,99.0)
	6/22-6/24	0.0	Trace	100.0	(90.5,100)
	6/25-6/27	15.5	(4.2,26.8)	84.5	(73.2,95.8)
	6/28-6/29	9.2	(0.0,20.0)	90.8	(80.0,100)
	6/30-7/03	4.9	(0.0,15.4)	95.1	(84.6,100)
	7/04-7/06	7.7	(0.0,18.4)	92.3	(81.6,100)
	7/07-7/08	4.9	(0.0,15.4)	95.1	(84.6,100)
	7/09-7/11	4.9	(0.0,15.4)	95.1	(84.6,100)
	7/12-8/26	0.7	(0.0,10.8)	99.3	(89.2,100)

[a] Kvichak, Naknek, and Ugashik Rivers combined.

[b] Trace was recorded for systems that were included in the model used to classify the catch, the point estimates were zero, and the upper bounds of the 90% C.I. was greater than zero.

Table 12. Estimated harvest of age-2.3 sockeye salmon and 90% confidence intervals (C.I.), Naknek-Kvichak and Egegik Districts, 1993.

District	River	Percent	Number	Standard Error	90% C.I. Lower	90% C.I. Upper
Naknek-Kvichak[a]	Egegik	12.7	321,261	60,285	221,914	420,397
	Other[b]	87.3	2,207,506	81,002	2,075,041	2,341,732
	Total	100.0	2,528,767			
Egegik	Egegik	92.6	9,304,107	267,051	8,865,258	9,744,502
	Other	7.4	746,975	257,219	327,223	1,174,095
	Total	100.0	10,051,082			

[a] June 9 through July 9 catches only.

[b] Kvichak, Naknek, and Ugashik Rivers combined.

Table 13. Run composition estimates of sockeye salmon catch by age group and date, Naknek-Kvichak District, 1993.

		1.2		1.3		2.2		1.4		2.3		2.4		Other[a]		Total	
Date	River	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/09[b]	Kvichak	91.0	56,534	75.9	168,696	72.2	156,981	6.5	318	36.2	115,399	0.0	0	0.0	0	60.0	497,928
thru	Naknek	7.9	4,906	19.9	44,316	1.9	4,131	74.3	3,643	37.3	118,906	81.5	3,995	0.0	0	21.7	179,897
6/23	Egegik	1.1	682	4.2	9,318	25.9	56,313	19.2	944	26.5	84,477	18.5	909	0.0	0	18.4	152,643
	Ugashik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Total	100.0	62,122	100.0	222,330	100.0	217,425	100.0	4,905	100.0	318,782	100.0	4,904	0.0	0	100.0	830,468
6/24[c]	Kvichak	70.3	21,805	42.5	29,815	37.0	41,694	1.6	26	10.8	22,753	0.0	0	0.0	0	27.1	116,093
thru	Naknek	26.3	8,172	48.2	33,824	5.0	5,634	79.4	1,297	57.0	120,083	82.6	1,350	0.0	0	39.8	170,360
6/26	Egegik	3.4	1,052	9.4	6,585	58.0	65,358	19.0	311	32.2	67,836	17.4	284	0.0	0	33.1	141,427
	Ugashik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Total	100.0	31,029	100.0	70,224	100.0	112,686	100.0	1,634	100.0	210,672	100.0	1,634	0.0	0	100.0	427,879
6/27	Kvichak	58.0	33,505	35.6	34,889	62.8	59,188	1.3	83	5.0	9,676	0.0	0	0.0	0	30.4	137,341
	Naknek	32.3	18,699	60.1	58,944	28.9	27,238	97.5	6,125	89.3	172,814	97.1	2,440	0.0	0	63.3	286,259
	Egegik	0.1	29	0.1	138	2.7	2,545	0.3	18	0.0	0	0.2	6	0.0	0	0.6	2,735
	Ugashik	9.6	5,573	4.1	4,046	5.6	5,278	0.9	58	5.7	11,031	2.7	68	0.0	0	5.8	26,053
	Total	100.0	57,805	100.0	98,017	100.0	94,248	100.0	6,283	100.0	193,521	100.0	2,514	0.0	0	100.0	452,388
6/28[c]	Kvichak	73.7	76,910	55.8	125,046	76.5	248,956	3.1	473	12.0	53,420	0.0	0	0.0	0	45.0	504,806
thru	Naknek	16.6	17,354	38.1	85,416	11.6	37,750	91.9	14,102	71.3	317,405	92.1	5,658	0.0	0	42.6	477,685
6/29	Egegik	0.3	347	1.2	2,579	7.4	24,082	3.4	525	7.7	34,278	3.0	185	0.0	0	5.5	61,995
	Ugashik	9.4	9,773	4.9	11,078	4.5	14,644	1.6	250	9.0	40,065	4.8	297	0.0	0	6.8	76,109
	Total	100.0	104,384	100.0	224,119	100.0	325,433	100.0	15,350	100.0	445,169	100.0	6,140	0.0	0	100.0	1,120,595
6/30[c]	Kvichak	78.4	130,224	60.7	100,746	56.5	254,616	0.0	0	4.6	11,820	0.0	0	96.0	7,590	48.2	504,996
thru	Naknek	13.4	22,268	31.4	52,151	18.7	84,271	0.0	0	59.5	152,885	0.0	0	0.0	0	29.7	311,575
7/01	Egegik	1.2	1,9[illegible]	4.1	6,879	20.1	90,580	0.0	0	31.0	79,654	0.0	0	0.0	0	17.1	179,056
	Ugashik	7.0	11,593	3.8	6,252	4.7	21,180	0.0	0	4.9	12,591	0.0	0	4.0	316	5.0	51,932
	Total	100.0	166,028	100.0	166,028	100.0	450,647	0.0	0	100.0	256,949	0.0	0	100.0	7,906	100.0	1,047,558

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Table 13. (p 2 of 3).

Date	River	1.2		1.3		2.2		1.4		2.3		2.4		Other[a]		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
7/02	Kvichak	84.0	369,318	63.2	363,354	72.1	401,560	3.8	268	8.0	26,393	0.0	0	0.0	0	60.6	1,160,893
	Naknek	15.9	69,803	36.2	207,898	21.1	117,516	94.3	6,691	92.0	303,520	98.2	3,485	0.0	0	37.0	708,912
	Egegik	0.2	763	0.6	3,436	6.8	37,873	1.9	136	0.0	0	1.8	62	100.0	3,547	2.4	45,817
	Ugashik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Total	100.0	439,884	100.0	574,688	100.0	556,949	100.0	7,095	100.0	329,913	100.0	3,547	100.0	3,547	100.0	1,915,623
7/04[c]	Kvichak	57.5	113,086	43.2	77,425	48.2	185,372	2.1	30	3.6	12,399	0.0	0	0.0	0	35.0	388,311
thru	Naknek	18.9	37,136	42.9	76,969	24.5	94,224	89.7	1,287	70.8	243,841	0.0	0	0.0	0	40.8	453,457
7/05	Egegik	0.5	1,073	1.9	3,361	11.4	43,843	4.8	69	10.6	36,507	0.0	0	100.0	4,305	8.0	89,159
	Ugashik	23.0	45,305	12.1	21,624	15.9	61,150	3.4	49	15.0	51,661	0.0	0	0.0	0	16.2	179,790
	Total	100.0	196,600	100.0	179,379	100.0	384,589	100.0	1,435	100.0	344,408	0.0	0	100.0	4,305	100.0	1,110,716
7/06[c]	Kvichak	58.4	110,104	35.8	65,040	44.8	89,725	1.3	44	3.4	8,455	0.0	0	0.0	0	33.0	273,369
thru	Naknek	31.3	59,092	58.1	105,672	29.3	58,682	93.6	3,125	86.7	215,605	93.7	3,128	0.0	0	53.8	445,304
7/07	Egegik	0.7	1,405	2.1	3,797	20.7	41,458	4.1	138	4.9	12,185	3.6	122	100.0	1,669	7.3	60,774
	Ugashik	9.5	17,996	4.1	7,411	5.2	10,415	0.9	30	5.0	12,434	2.7	89	0.0	0	5.8	48,375
	Total	100.0	188,597	100.0	181,921	100.0	200,280	100.0	3,338	100.0	248,679	100.0	3,338	100.0	1,669	100.0	827,822
7/08[c]	Kvichak	66.3	61,003	46.4	48,656	56.0	105,418	2.1	160	4.8	8,672	0.0	0	58.8	1,910	39.2	225,821
thru	Naknek	22.2	20,424	47.0	49,313	25.0	47,062	93.3	7,070	84.0	151,768	0.0	0	3.1	102	47.8	275,739
7/09	Egegik	0.4	361	1.3	1,318	12.0	22,590	3.1	233	3.5	6,324	0.0	0	36.1	1,171	5.5	31,996
	Ugashik	11.1	10,173	5.4	5,657	7.0	13,177	1.5	111	7.7	13,912	0.0	0	1.9	63	7.5	43,093
	Total	100.0	91,961	100.0	104,944	100.0	188,247	100.0	7,574	100.0	180,676	0.0	0	100.0	3,246	100.0	576,648
7/10[c]	Kvichak	60.1	24,897	33.7	14,696	51.5	48,778	1.2	44	3.2	3,052	0.0	0	0.0	0	32.7	91,466
thru	Naknek	37.7	15,630	64.1	27,929	36.2	34,286	95.8	3,608	87.9	83,768	97.0	522	0.0	0	59.2	165,743
7/11	Egegik	0.6	258	1.6	697	11.4	10,797	2.9	111	8.1	7,749	2.6	14	100.0	538	7.2	20,164
	Ugashik	1.6	651	0.6	268	0.9	852	0.1	5	0.7	682	0.4	2	0.0	0	0.9	2,460
	Total	100.0	41,436	100.0	43,589	100.0	94,714	100.0	3,767	100.0	95,251	100.0	538	100.0	538	100.0	279,833

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Table 13. (p 3 of 3).

Date	River	1.2 %	1.2 Number	1.3 %	1.3 Number	2.2 %	2.2 Number	1.4 %	1.4 Number	2.3 %	2.3 Number	2.4 %	2.4 Number	Other[a] %	Other[a] Number	Total %	Total Number
7/12[c]	Kvichak	46.5	10,581	22.6	10,605	39.0	24,203	0.7	30	1.9	1,915	0.0	0	39.9	712	20.0	48,047
thru	Naknek	51.1	11,631	75.3	35,291	48.0	29,788	96.9	4,325	90.8	92,044	97.6	435	5.9	106	72.4	173,621
7/14	Egegik	0.7	152	1.5	699	12.0	7,447	2.4	106	6.7	6,760	2.1	9	53.9	962	6.7	16,134
	Ugashik	1.8	406	0.6	284	1.0	621	0.1	5	0.6	628	0.3	1	0.3	5	0.8	1,949
	Total	100.0	22,770	100.0	46,879	100.0	62,059	100.0	4,465	100.0	101,347	100.0	446	100.0	1,785	100.0	239,751
7/16[d]	Kvichak	1.2	71	0.5	48	1.2	158	0.0	0	0.0	16	0.0	0	3.4	9	0.4	302
thru	Naknek	77.2	4,489	93.5	9,098	84.7	11,131	99.1	2,129	94.8	44,322	97.5	739	77.4	195	91.7	72,103
8/06	Egegik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Ugashik	21.5	1,252	6.0	584	14.1	1,853	0.9	19	5.2	2,415	2.5	19	19.1	48	7.9	6,190
	Total	100.0	5,812	100.0	9,730	100.0	13,142	100.0	2,148	100.0	46,753	100.0	758	100.0	252	100.0	78,595
Total	Kvichak	71.6	1,008,038	54.1	1,039,017	59.9	1,616,649	2.5	1,476	9.9	273,970	0.0	0	44.0	10,222	44.3	3,949,371
	Naknek	20.6	289,603	40.9	786,821	20.4	551,715	92.1	53,401	72.8	2,016,961	91.3	21,751	1.7	403	41.8	3,720,655
	Egegik	0.6	8,065	2.0	38,806	14.9	402,885	4.5	2,590	12.1	335,771	6.7	1,591	52.4	12,191	9.0	801,900
	Ugashik	7.3	102,722	3.0	57,204	4.8	129,170	0.9	527	5.2	145,418	2.0	477	1.9	432	4.9	435,950
	Total	100.0	1,408,428	100.0	1,921,848	100.0	2,700,419	100.0	57,994	100.0	2,772,120	100.0	23,819	100.0	23,248	100.0	8,907,876

[a] Other includes ages-1.1, -0.3, -2.1, -3.2, and -3.3.

[b] Scale samples were collected on 22 June. Stock composition estimates calculated for this date were applied to 9 through 23 June catches.

[c] Naknek Section only openings.

[d] Reduced Naknek Section only openings occurred on 16 and 18 July. Scale samples collected on these dates were used to produce stock composition estimates that were applied to 16 July through 6 August catches.

Table 14. Run composition estimates of sockeye salmon catch by age group and date, Egegik District, 1993.

		1.2		1.3		2.2		1.4		2.3		3.2		Other		Total	
Date	River	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/17[b]	Kvichak	65.2	2,372	45.2	27,947	15.6	38,889	1.8	33	6.3	32,785	0.0	0	0.0	0	11.9	102,026
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
6/21	Egegik	14.1	514	44.8	27,733	83.3	207,655	95.8	1,744	88.0	457,955	100.0	3,640	98.1	14,275	83.4	713,517
	Ugashik	20.7	753	10.0	6,187	1.1	2,742	2.4	43	5.7	29,663	0.0	0	1.9	281	4.6	39,669
	Total	100.0	3,640	100.0	61,867	100.0	249,286	100.0	1,820	100.0	520,403	100.0	3,640	100.0	14,556	100.0	855,212
6/22	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
6/24	Egegik	65.1	15,617	92.5	99,794	95.3	542,924	99.1	5,943	100.0	959,493	0.0	0	98.5	11,816	97.4	1,635,586
	Ugashik	34.9	8,371	7.5	8,149	4.7	26,776	0.9	54	0.0	0	0.0	0	1.5	178	2.6	43,529
	Total	100.0	23,988	100.0	107,943	100.0	569,700	100.0	5,997	100.0	959,493	0.0	0	100.0	11,994	100.0	1,679,115
6/25	Kvichak	19.9	6,005	6.3	10,938	2.6	31,523	0.1	41	0.1	1,798	0.0	0	0.0	0	1.5	50,305
thru	Naknek	43.9	13,237	41.7	72,984	8.7	105,481	39.4	11,875	15.4	276,818	0.0	0	42.6	10,272	15.0	490,666
6/27	Egegik	36.2	10,918	52.0	91,005	88.7	1,075,418	60.5	18,244	84.5	1,518,905	100.0	12,064	57.4	13,856	83.5	2,740,410
	Ugashik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Total	100.0	30,160	100.0	174,926	100.0	1,212,422	100.0	30,160	100.0	1,797,521	100.0	12,064	100.0	24,128	100.0	3,281,381
6/28	Kvichak	2.8	2,218	0.8	1,287	0.0	0	0.0	0	0.2	2,426	0.0	0	0.0	0	0.2	5,930
thru	Naknek	18.4	14,485	16.7	25,441	0.0	0	14.7	0	6.8	82,469	0.0	0	16.2	750	5.0	123,145
6/29	Egegik	57.0	44,855	78.0	119,096	100.0	999,845	84.7	0	90.8	1,101,202	0.0	0	82.0	3,797	92.7	2,268,794
	Ugashik	21.8	17,133	4.5	6,930	0.0	0	0.5	0	2.2	26,681	0.0	0	1.8	83	2.1	50,827
	Total	100.0	78,691	100.0	152,754	100.0	999,845	100.0	0	100.0	1,212,777	0.0	0	100.0	4,629	100.0	2,448,696
6/30	Kvichak	7.1	11,180	3.9	12,173	1.1	31,290	0.1	35	0.0	0	0.0	0	0.0	0	0.9	54,678
thru	Naknek	2.3	3,701	3.9	12,200	0.9	25,601	4.2	1,540	1.0	28,324	0.0	0	4.4	1,073	1.2	72,440
7/03	Egegik	27.4	43,333	68.3	215,922	87.8	2,497,541	92.1	33,584	95.2	2,696,468	100.0	24,313	84.5	20,539	88.7	5,531,699
	Ugashik	63.2	99,818	24.0	75,770	10.2	290,147	3.6	1,310	3.8	107,632	0.0	0	11.1	2,700	9.3	577,378
	Total	100.0	158,032	100.0	316,065	100.0	2,844,580	100.0	36,469	100.0	2,832,424	100.0	24,313	100.0	24,312	100.0	6,236,195

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Table 14. (p 2 of 2).

Date	River	1.2 %	1.2 Number	1.3 %	1.3 Number	2.2 %	2.2 Number	1.4 %	1.4 Number	2.3 %	2.3 Number	3.2 %	3.2 Number	Other[a] %	Other[a] Number	Total %	Total Number
7/04	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/06	Egegik	16.5	21,288	56.5	117,933	79.4	1,194,692	0.0	0	92.3	1,286,756	100.0	6,141	38.8	4,765	80.8	2,631,576
	Ugashik	83.5	107,681	43.5	90,875	20.6	309,958	0.0	0	7.7	107,346	0.0	0	61.2	7,717	19.2	623,376
	Total	100.0	128,969	100.0	208,808	100.0	1,504,650	0.0	0	100.0	1,394,102	100.0	6,141	100.0	12,282	100.0	3,254,952
7/07	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
thru	Naknek	17.3	1,628	19.6	11,027	5.4	51,872	18.3	1,722	3.8	24,018	0.0	0	9.9	1,235	5.4	91,502
7/08	Egegik	40.7	3,824	69.5	39,156	90.1	865,492	80.3	7,534	95.1	601,081	100.0	12,516	87.9	11,002	91.0	1,540,605
	Ugashik	41.9	3,935	10.9	6,139	4.5	43,227	1.4	131	1.1	6,953	0.0	0	2.2	279	3.6	60,663
	Total	100.0	9,387	100.0	56,322	100.0	960,591	100.0	9,387	100.0	632,051	100.0	12,516	100.0	12,516	100.0	1,692,770
7/09	Kvichak	42.8	10,688	32.0	11,601	9.2	71,365	0.0	0	0.3	1,082	0.0	0	0.0	0	7.7	94,735
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/11	Egegik	13.2	3,300	45.2	16,395	79.3	615,132	0.0	0	95.1	342,963	100.0	31,754	100.0	2,268	82.2	1,011,812
	Ugashik	43.9	10,962	22.9	8,295	11.5	89,206	0.0	0	4.6	16,589	0.0	0	0.0	0	10.2	125,052
	Total	100.0	24,950	100.0	36,291	100.0	775,702	0.0	0	100.0	360,634	100.0	31,754	100.0	2,268	100.0	1,231,599
7/12[b]	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
thru	Naknek	10.8	1,062	13.8	4,749	5.2	26,683	13.4	329	0.5	1,708	0.0	0	0.0	0	3.7	34,531
8/26	Egegik	36.6	3,587	70.7	24,242	87.6	449,501	84.5	2,071	99.3	339,285	100.0	15,921	100.0	3,674	91.0	838,281
	Ugashik	52.5	5,147	15.5	5,299	7.2	36,945	2.1	50	0.2	683	0.0	0	0.0	0	5.2	48,125
	Total	100.0	9,797	100.0	34,290	100.0	513,129	100.0	2,450	100.0	341,677	100.0	15,921	100.0	3,674	100.0	920,938
Total	Kvichak	6.9	32,463	5.6	63,945	1.8	173,067	0.1	109	0.4	38,090	0.0	0	0.0	0	1.4	307,674
	Naknek	7.3	34,114	11.0	126,401	2.2	209,637	17.9	15,466	4.1	413,338	0.0	0	12.1	13 330	3.8	812,284
	Egegik	31.5	147,236	65.4	751,276	87.7	8,448,201	80.1	69,120	92.6	9,304,107	100.0	106,349	77.9	85,992	87.5	18,912,281
	Ugashik	54.3	253,802	18.1	207,643	8.3	799,001	1.8	1,588	2.9	295,547	0.0	0	10.0	11 037	7.3	1,568,619
	Total	100.0	467,614	100.0	1,149,266	100.0	9,629,905	100.0	86,283	100.0	10,051,082	100.0	106,349	100.0	110,359	100.0	21,600,858

[a] Other includes age-0.3, -2.4, and -3.3.

[b] Scale samples were collected on 20 and 21 June. Stock composition estimates calculated for that date were applied to 17 through 21 June catches.

[c] Scale samples were collected on 12, 13, and 14 July. Stock composition estimates calculated for these dates were applied to 12 July through 26 August catches.

Table 15. Run composition estimates of sockeye salmon catch by age group and date, Ugashik District, 1993.

		1.2		1.3		2.2		1.4		2.3		2.4		Other[a]		Total	
Date	System	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/09[b]	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
thru	Naknek	10.7	2,409	29.8	8,970	8.2	3,791	53.3	729	22.5	18,699	0.0	0	0.0	0	18.7	34,598
6/30	Egegik	3.6	807	15.1	4,540	52.4	24,224	33.2	455	42.2	35,102	0.0	0	0.0	0	35.3	65,127
	Ugashik	85.8	19,386	55.2	16,624	39.4	18,214	13.5	185	35.3	29,411	0.0	0	100.0	1,027	46.0	84,847
	Total	100.0	22,601	100.0	30,134	100.0	46,229	100.0	1,369	100.0	83,212	0.0	0	100.0	1,027	100.0	184,572
7/01	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
thru	Naknek	16.7	24,039	45.4	61,975	21.1	63,580	81.1	4,864	45.5	166,448	0.0	0	0.0	0	33.6	320,907
7/06	Egegik	0.7	991	2.8	3,862	16.6	50,020	6.2	374	10.5	38,467	0.0	0	0.0	0	9.8	93,714
	Ugashik	82.6	118,887	51.7	70,585	62.3	187,727	12.6	758	44.0	160,874	0.0	0	100.0	2,998	56.6	541,828
	Total	100.0	143,917	100.0	136,422	100.0	301,327	100.0	5,996	100.0	365,789	0.0	0	100.0	2,998	100.0	956,449
7/07	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
thru	Naknek	10.8	10,030	33.4	44,267	14.0	64,805	72.5	3,557	33.7	167,999	53.4	2,619	0.0	0	24.5	293,278
7/08	Egegik	0.7	646	3.3	4,308	17.2	79,618	8.7	427	12.2	60,630	5.6	275	0.0	0	12.2	145,904
	Ugashik	88.5	82,558	63.3	83,913	68.8	318,471	18.8	923	54.2	270,251	41.0	2,012	0.0	0	63.3	758,128
	Total	100.0	93,233	100.0	132,489	100.0	462,894	100.0	4,907	100.0	498,880	100.0	4,907	0.0	0	100.0	1,197,310
7/09	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Naknek	13.1	2,056	39.1	6,754	18.6	41,451	0.0	0	41.4	67,175	60.5	949	1.3	98	27.7	118,483
	Egegik	0.3	46	1.3	230	8.0	17,829	0.0	0	5.2	8,487	2.2	35	81.4	6,388	7.7	33,015
	Ugashik	86.6	13,592	59.5	10,280	73.4	163,577	0.0	0	53.4	86,774	37.3	585	17.4	1,362	64.6	276,171
	Total	100.0	15,695	100.0	17,264	100.0	222,857	0.0	0	100.0	162,436	100.0	1,569	100.0	7,848	100.0	427,669
7/10	Kvichak	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
thru	Naknek	9.9	5,261	31.2	25,811	12.4	44,563	69.0	1,078	30.7	95,980	50.4	787	3.7	117	21.3	173,597
7/12	Egegik	0.9	465	4.2	3,446	20.9	75,110	11.4	177	15.2	47,521	7.3	113	66.3	1,562	15.8	128,905
	Ugashik	89.2	47,399	64.7	53,555	66.7	239,704	19.6	306	54.1	168,999	42.4	662	29.9	935	62.8	511,559
	Total	100.0	53,124	100.0	82,812	100.0	359,376	100.0	1,562	100.0	312,500	100.0	1,562	100.0	3,124	100.0	814,060

-Continued-

Table 15. (p 2 of 2).

Date	System	1.2 %	1.2 Number	1.3 %	1.3 Number	2.2 %	2.2 Number	1.4 %	1.4 Number	2.3 %	2.3 Number	2.4 %	2.4 Number	Other[a] %	Other[a] Number	Total %	Total Number
7/13[c]	Kvichak	2.6	907	3.2	1,525	3.3	7,169	0.3	17	0.2	699	0.0	0	0.0	0	1.7	10,317
thru	Naknek	3.4	1,203	12.9	6,122	4.9	10,645	47.7	2,910	14.1	40,551	26.5	648	0.0	0	10.4	62,080
8/17	Egegik	0.4	144	2.3	1,108	11.2	24,333	10.6	649	9.5	27,228	5.2	127	100.0	1,221	9.2	54,810
	Ugashik	93.6	33,142	81.6	38,845	80.6	175,108	41.4	2,527	76.1	218,345	68.3	1,666	0.0	0	78.7	469,633
	Total	100.0	35,396	100.0	47,601	100.0	217,255	100.0	6,103	100.0	286,823	100.0	2,441	100.0	1,221	100.0	596,840
Total	Kvichak	0.2	907	0.3	1,525	0.4	7,169	0.1	17	0.0	699	0.0	0	0.0	0	0.2	10,317
	Naknek	12.4	44,997	34.5	153,899	14.2	228,835	65.9	13,139	32.6	556,853	47.7	5,003	1.3	216	24.0	1,002,942
	Egegik	0.9	3,099	3.9	17,495	16.8	271,133	10.4	2,082	12.7	217,435	5.3	550	59.7	9,681	12.5	521,475
	Ugashik	86.5	314,963	61.3	273,802	68.5	1,102,800	23.6	4,700	54.7	934,653	47.0	4,926	39.0	6,321	63.3	2,642,166
	Total	100.0	363,966	100.0	446,722	100.0	1,609,938	100.0	19,937	100.0	1,709,640	100.0	10,479	100.0	16,218	100.0	4,176,900

[a] Other includes ages-0.3, -2.1 and -3.2.

[b] Scale samples were collected on 30 June. Stock composition estimates calculated for that date were applied to 9 through 30 June catches.

[c] Scale samples were collected on 13 July. Stock composition estimates calculated for that date were applied to 13 July through 17 August catches.

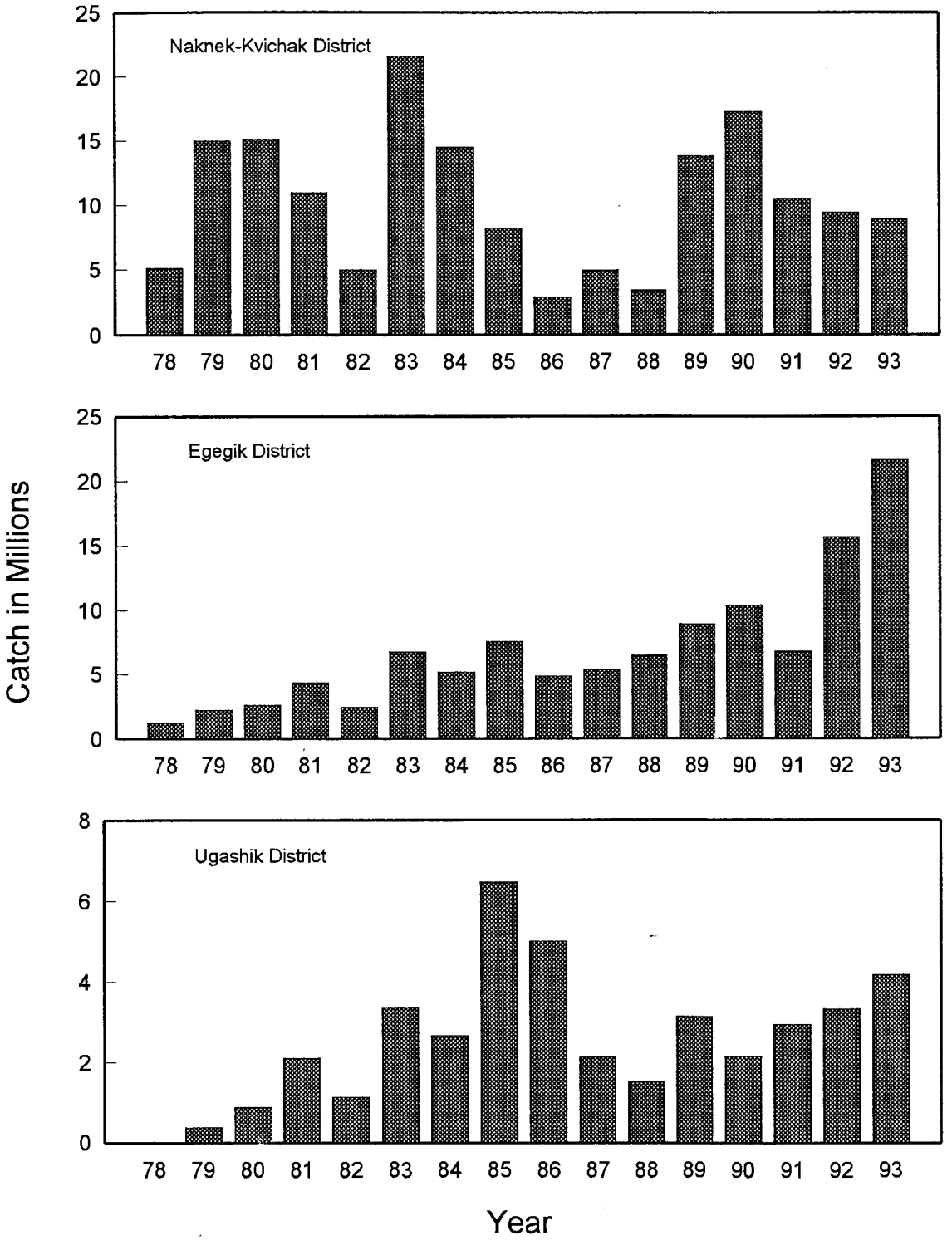

Figure 2. Commercial catch of sockeye salmon in Naknek-Kvichak, Egegik, and Ugashik Districts from 1978 through 1993.

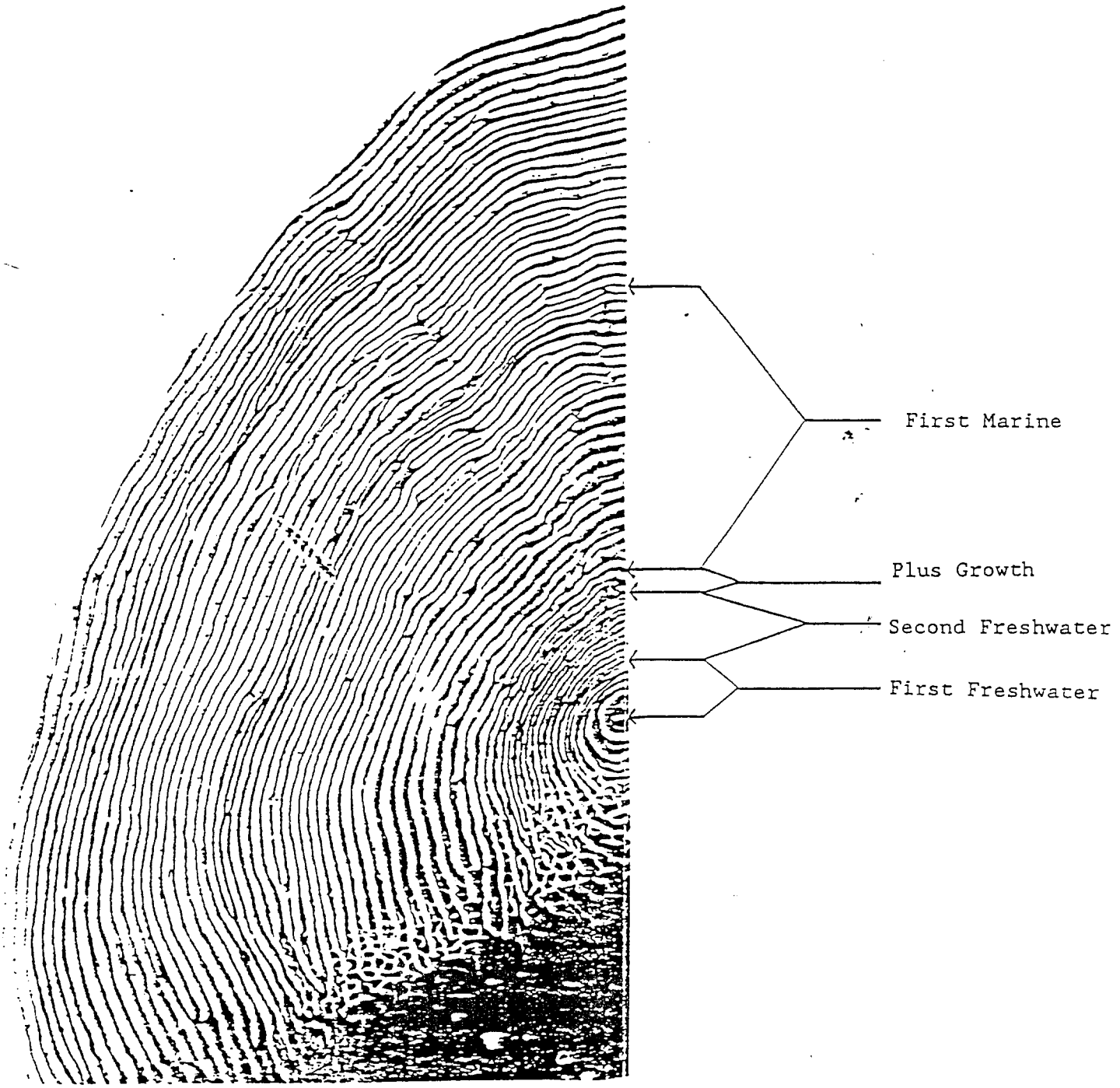

Figure 3. Age-2.2 sockeye salmon scale showing the growth zones measured to generate variables to build linear discriminant functions.

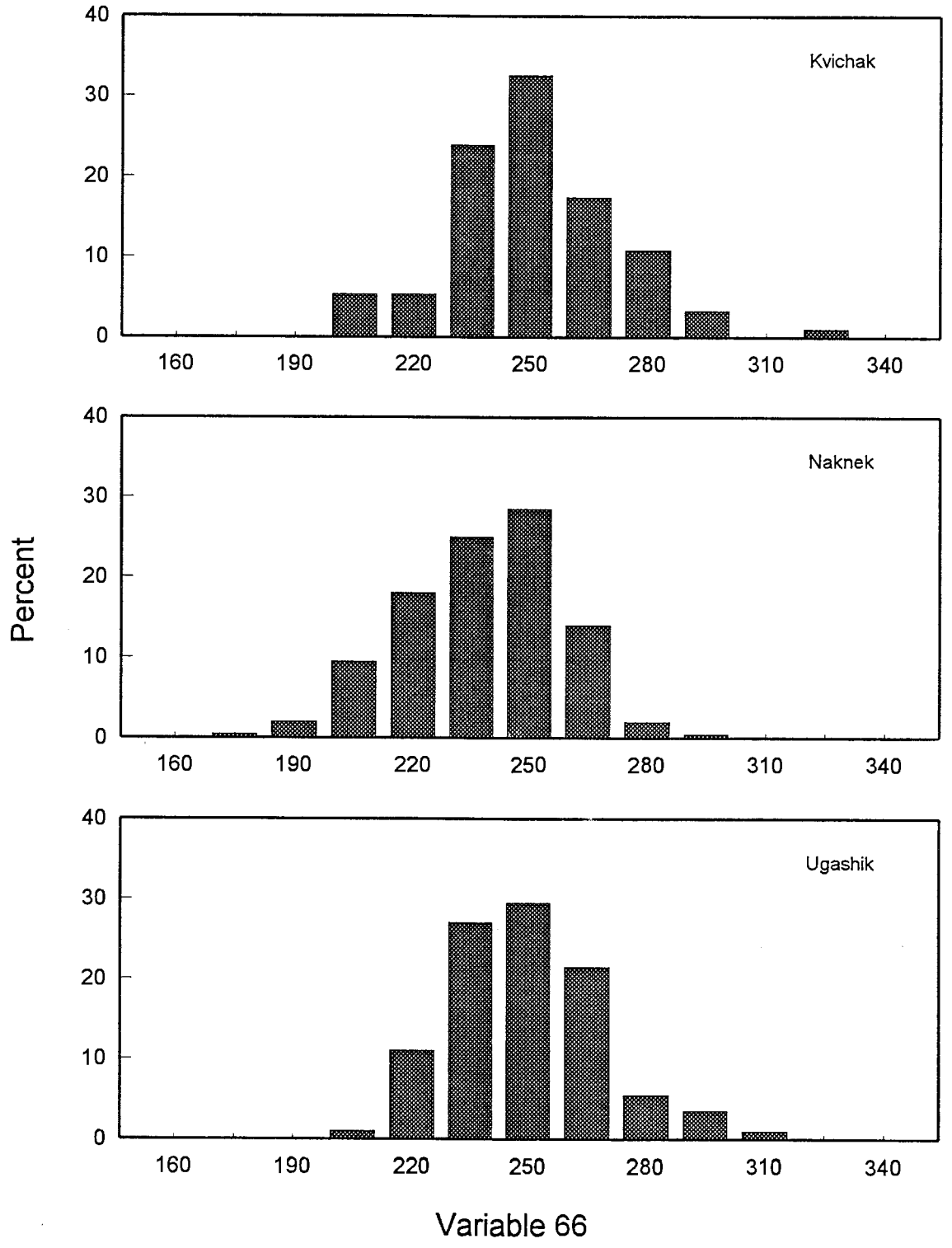

Figure 4. Total size of all freshwater growth zones (S1FW+S2FW+SPGZ) for age-2.3 sockeye salmon escapement scales, Kvichak, Naknek, and Ugashik Rivers, 1993.

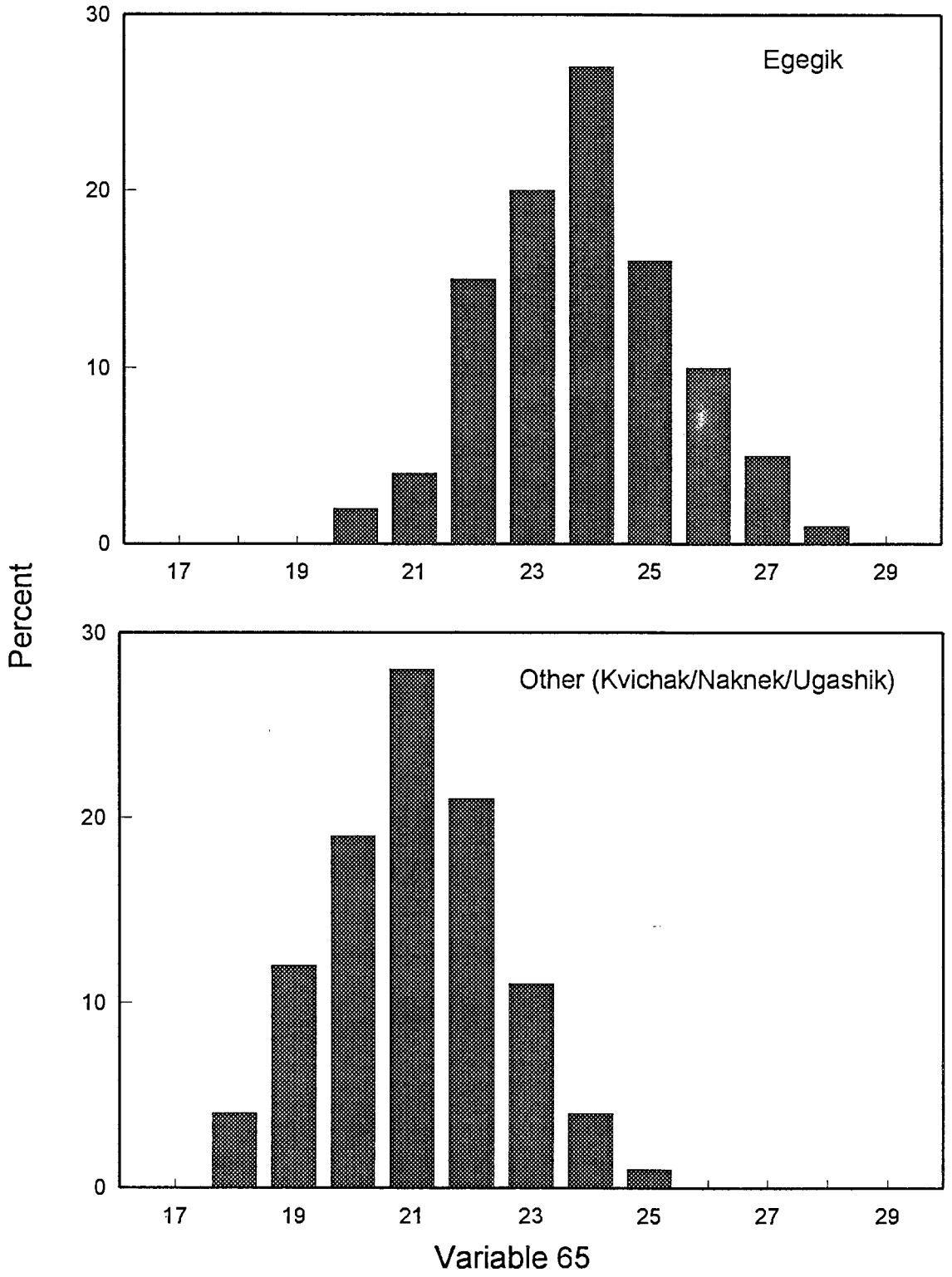

Figure 6. Total number of circuli in all freshwater growth zones (N1FW+N2FW+NPGZ) for age-2.3 sockeye salmon escapement scales, Egegik and Kvichak/Naknek/Ugashik (Other) Rivers combined, 1993.

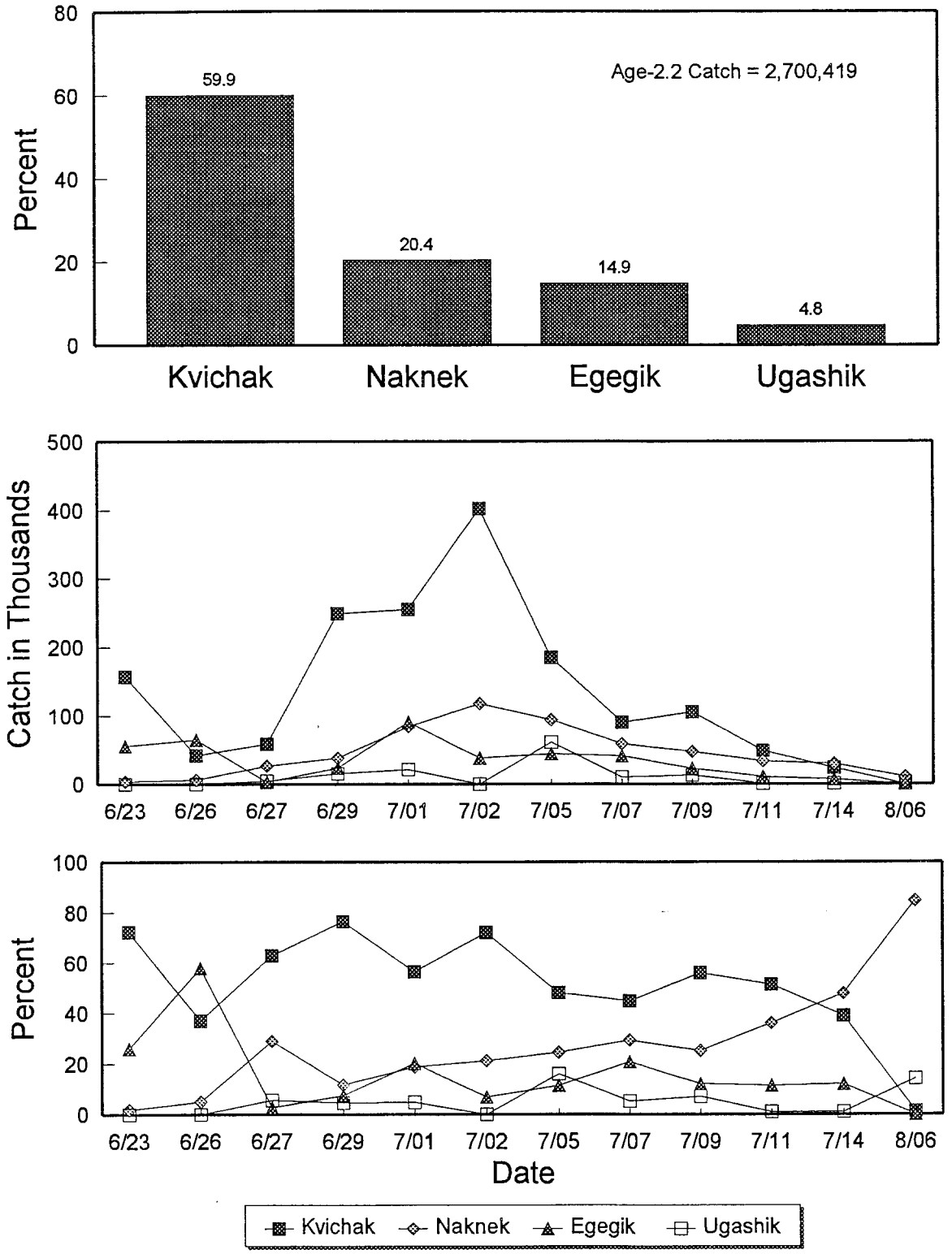

Figure 7. Stock composition estimates for 1993 Naknek-Kvichak District age-2.2 sockeye salmon catch in percent and numbers through time.

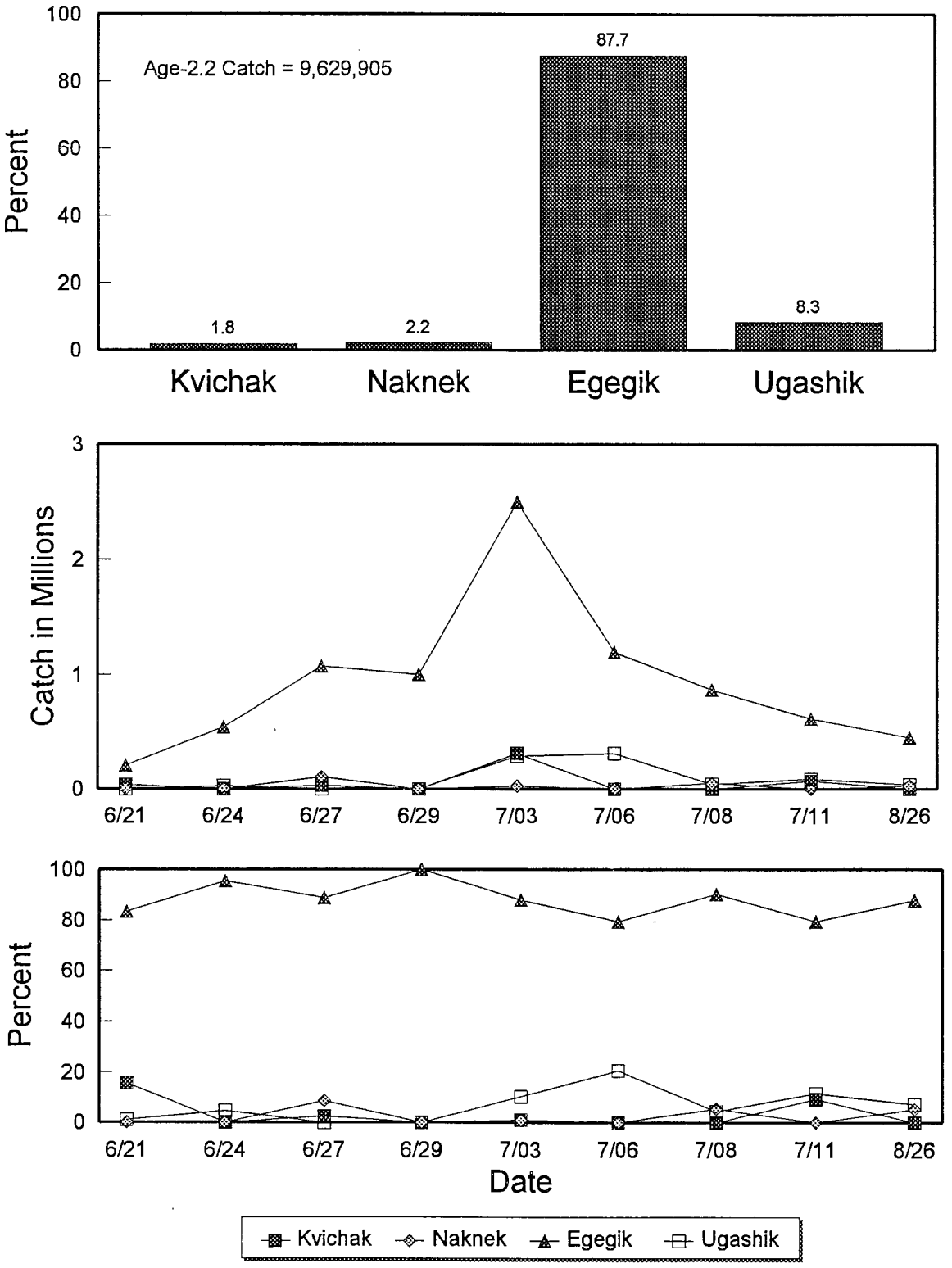

Figure 8. Stock composition estimates for 1993 Egegik District age-2.2 sockeye salmon catch in percent and numbers through time.

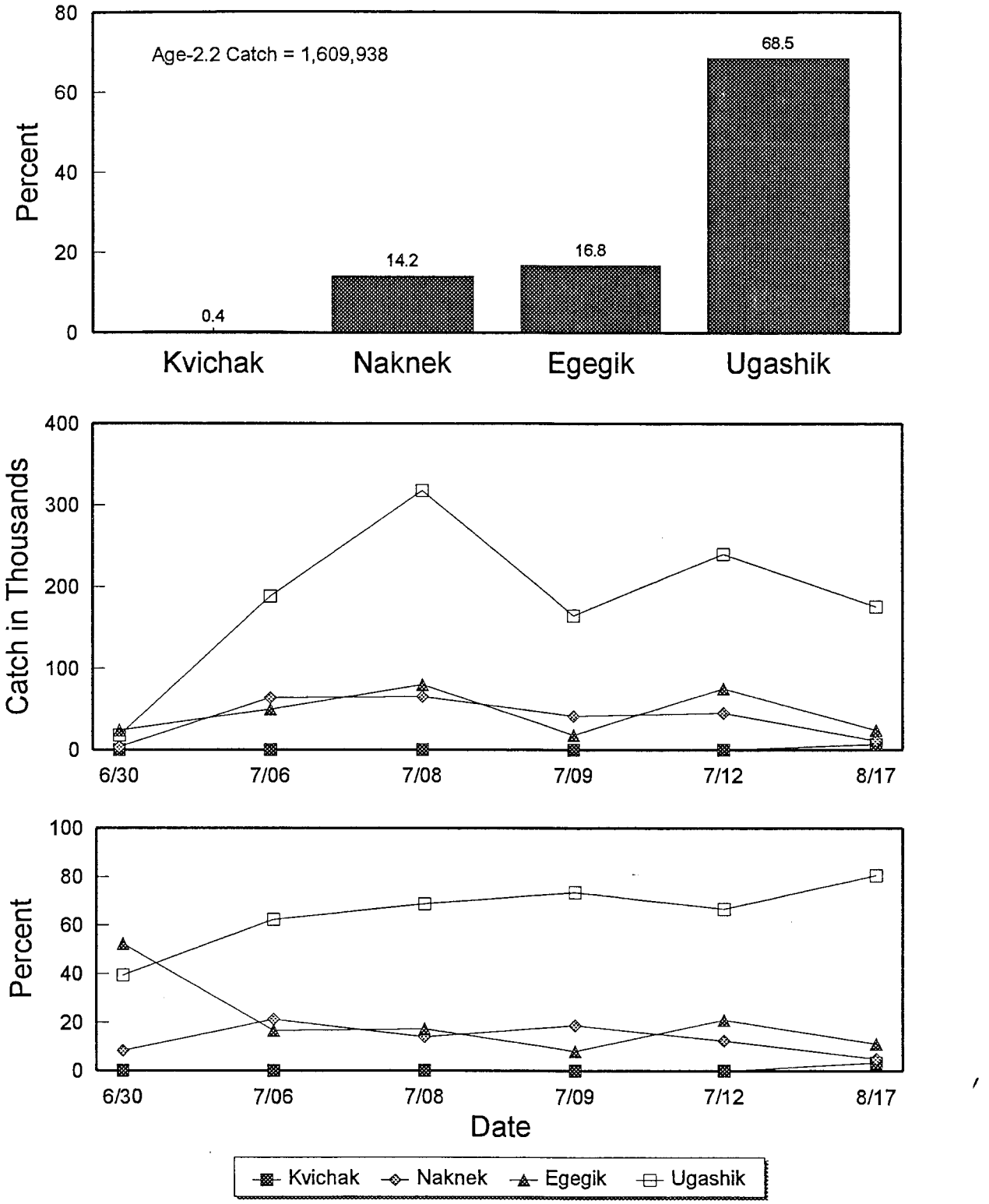

Figure 9. Stock composition estimates for 1993 Ugashik District age-2.2 sockeye salmon catch in percent and numbers through time.

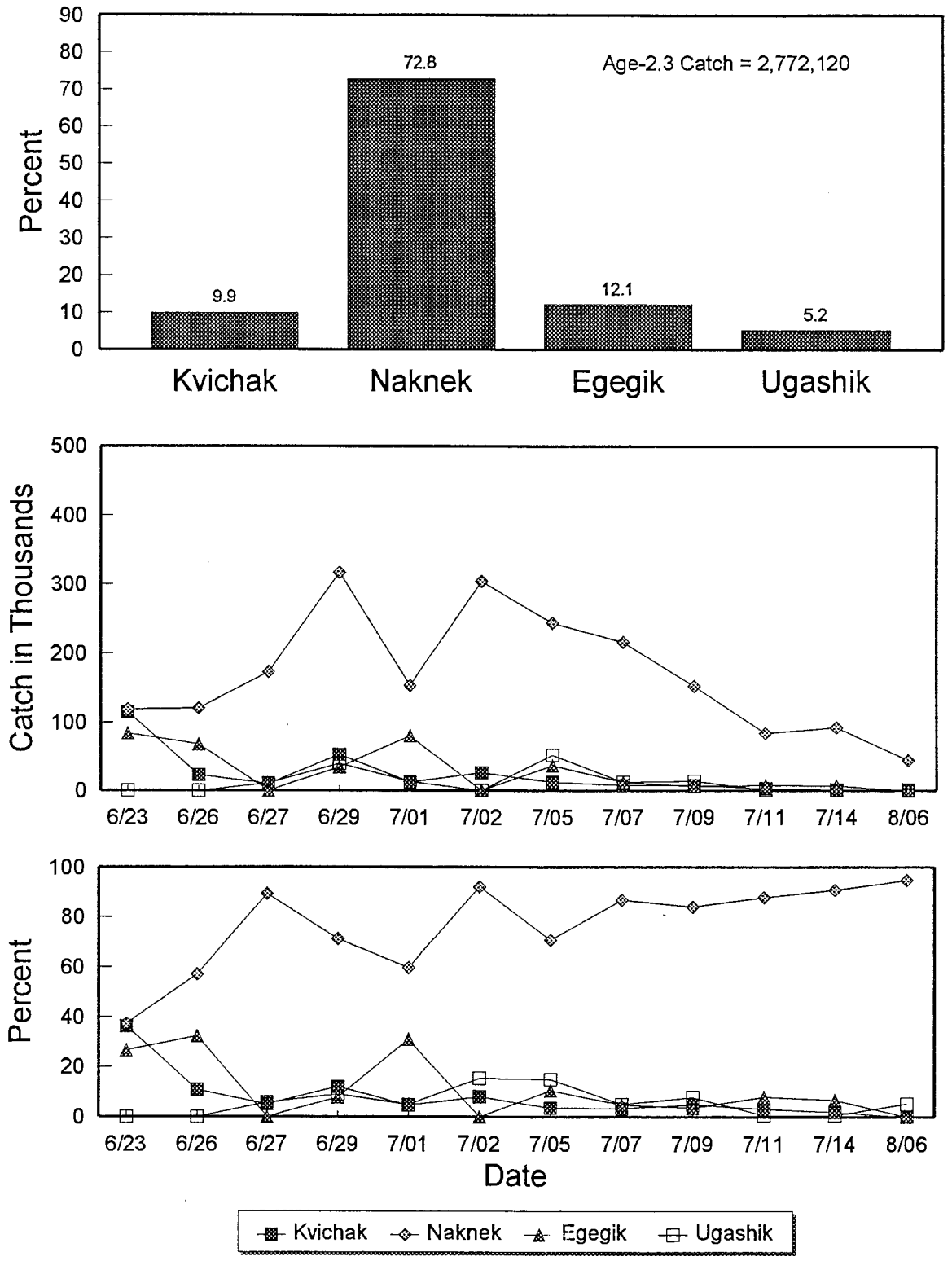

Figure 10. Stock composition estimates for 1993 Naknek-Kvichak District age-2.3 sockeye salmon catch in percent and numbers through time.

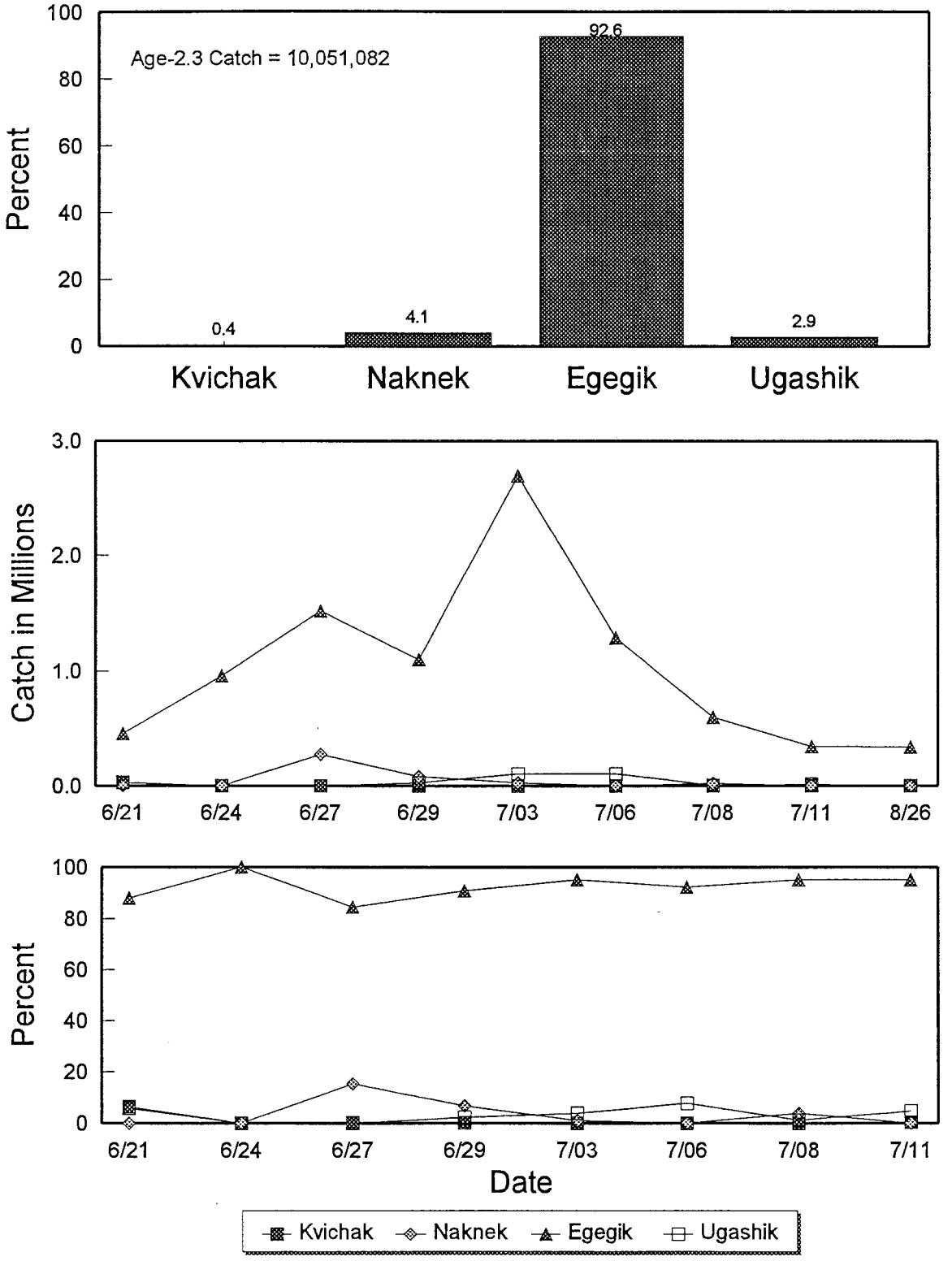

Figure 11. Stock composition estimates for 1993 Egegik District age-2.3 sockeye salmon catch in percent and numbers through time.

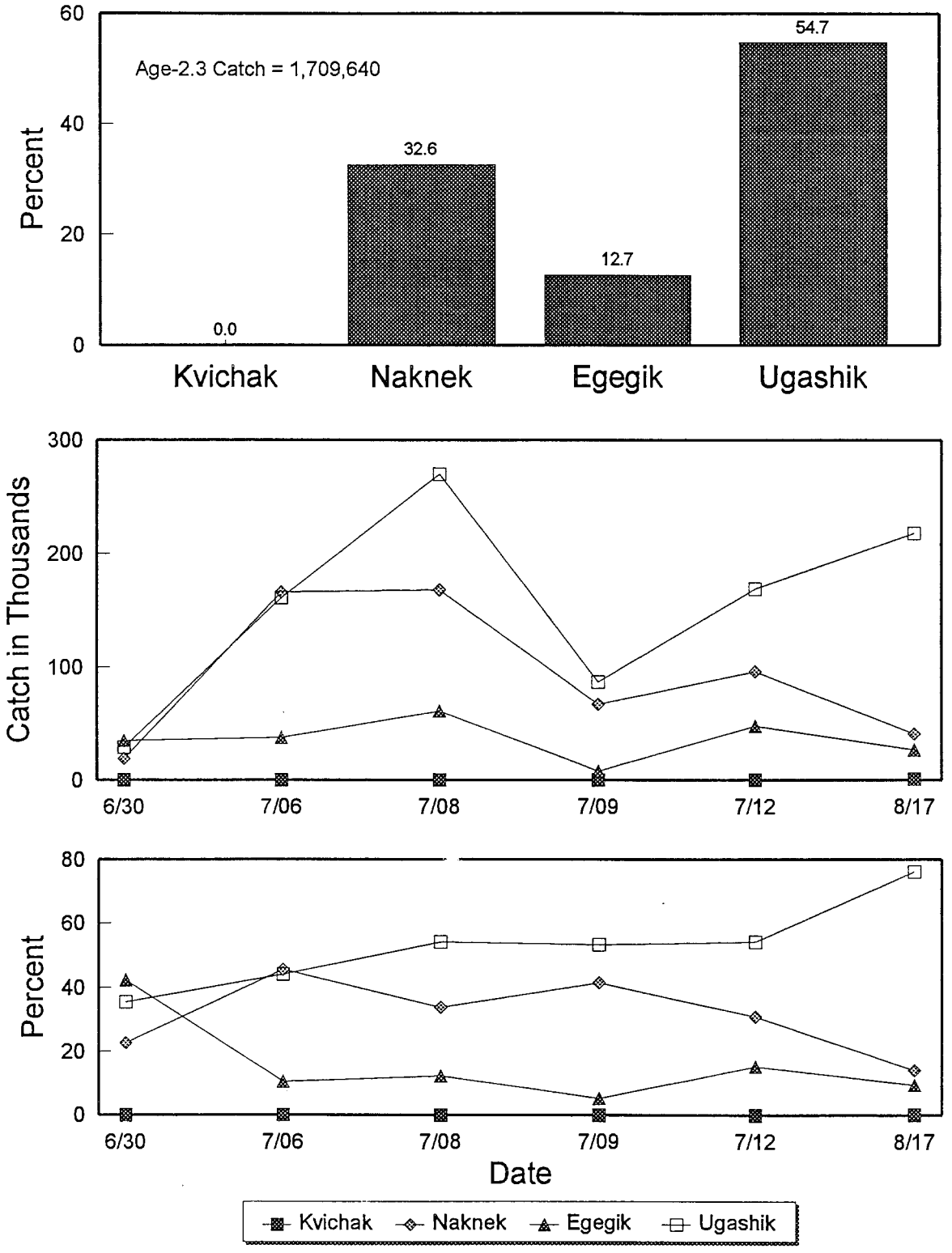

Figure 12. Stock composition estimates for 1993 Ugashik District age-2.3 sockeye salmon catch in percent and numbers through time.

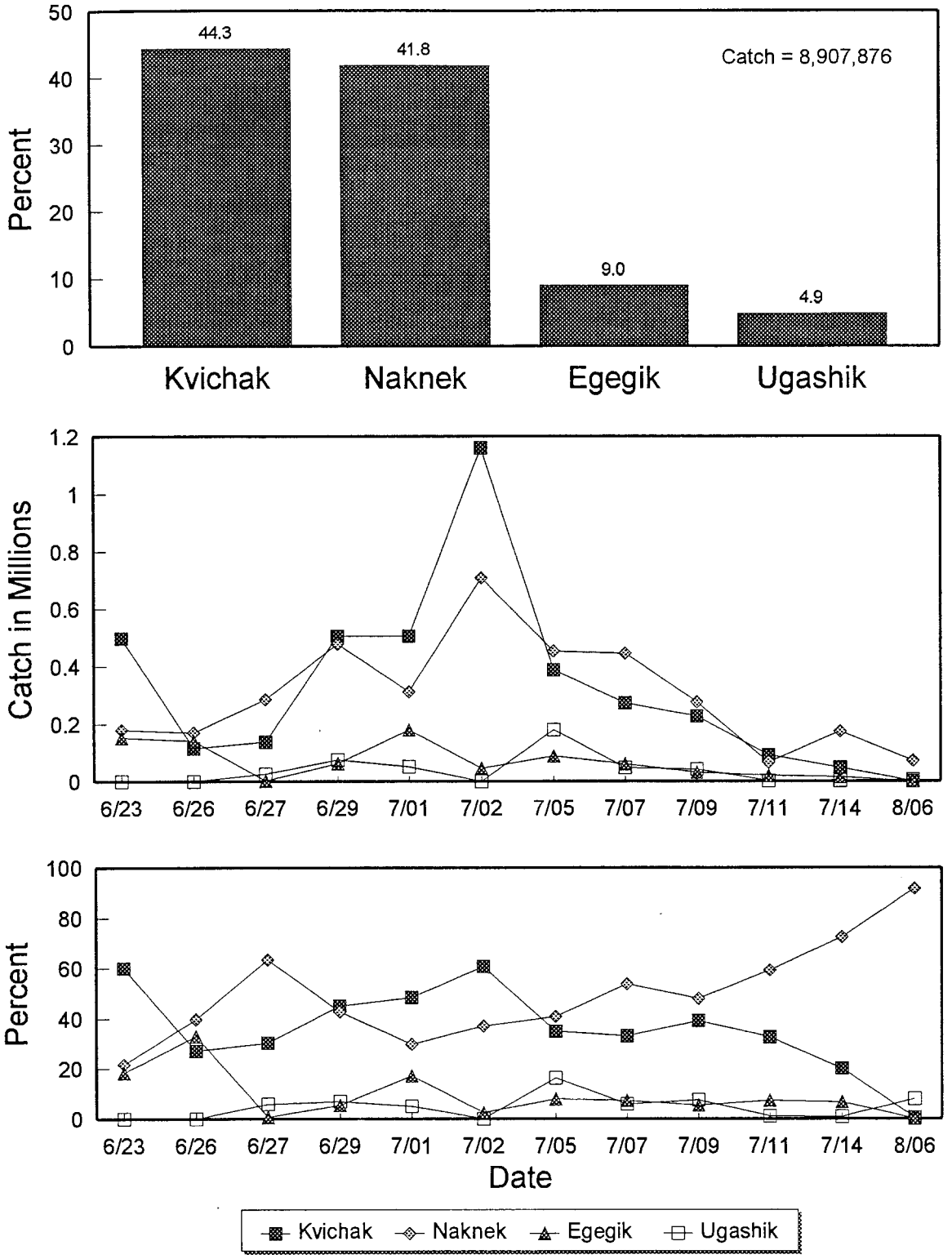

Figure 13. Stock composition estimates for 1993 Naknek-Kvichak District total sockeye salmon catch in percent and numbers through time.

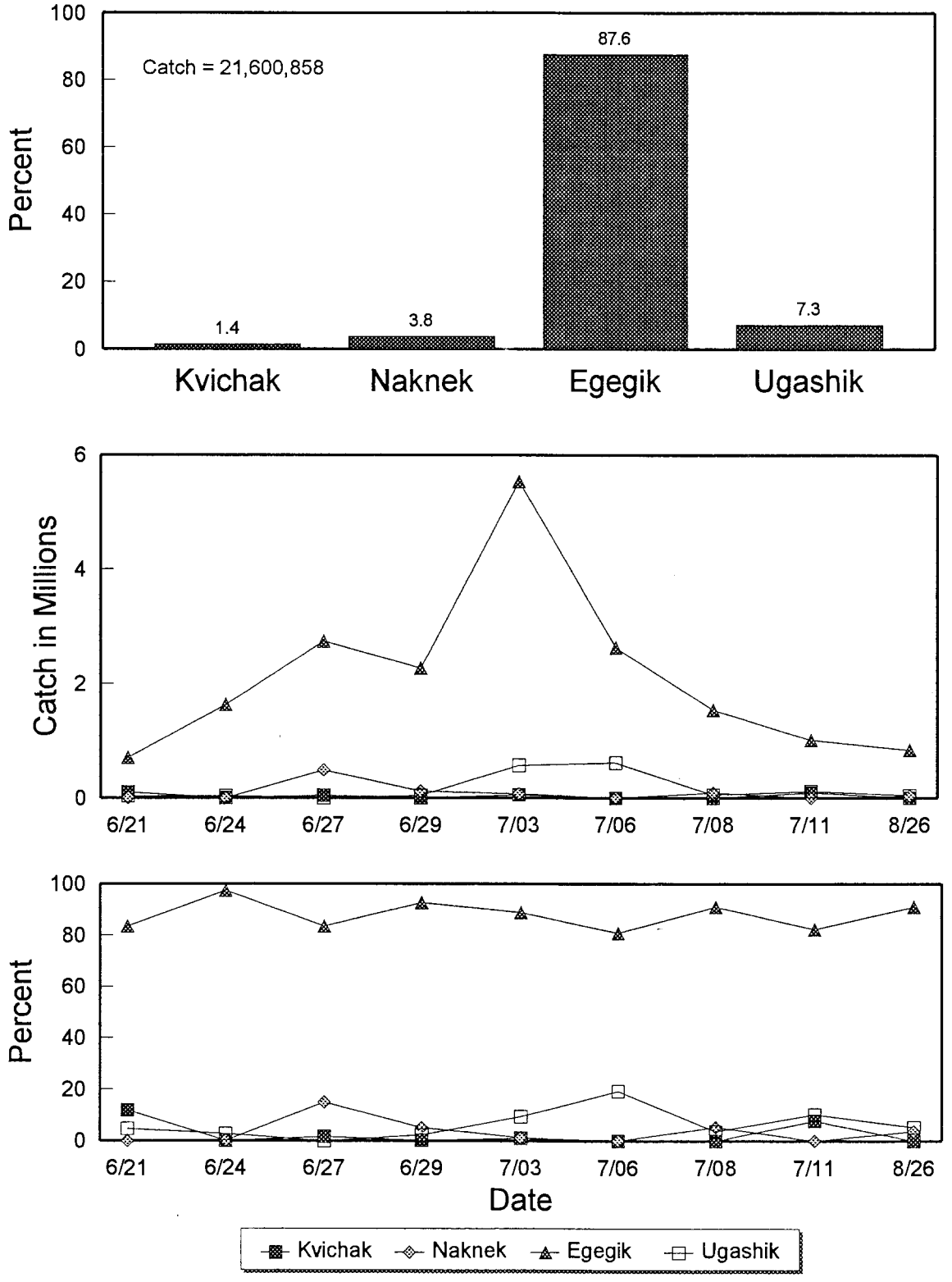

Figure 14. Stock composition estimates for 1993 Egegik District total sockeye salmon catch in percent and numbers through time.

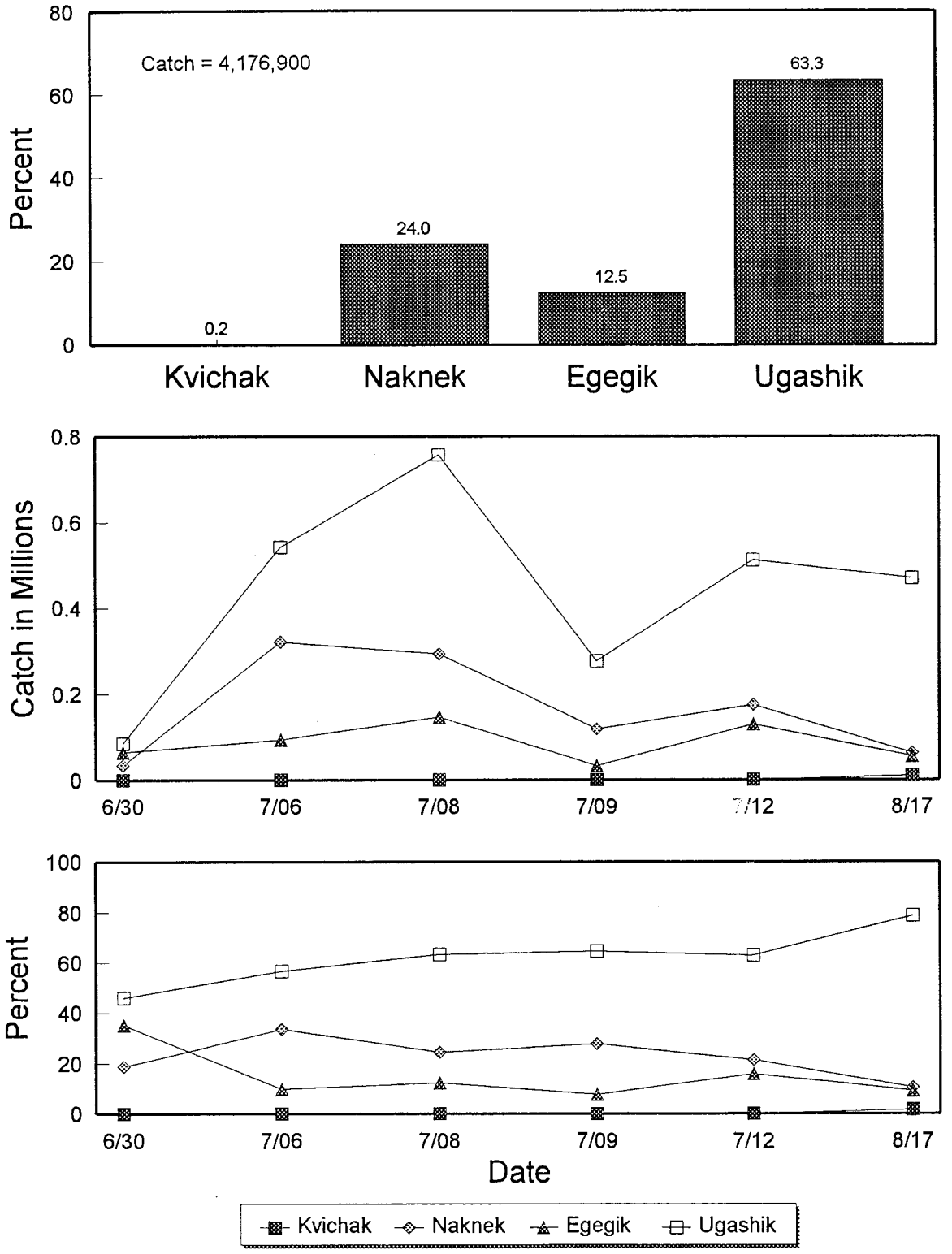

Figure 15. Stock composition estimates for 1993 Ugashik District total sockeye salmon catch in percent and numbers through time.

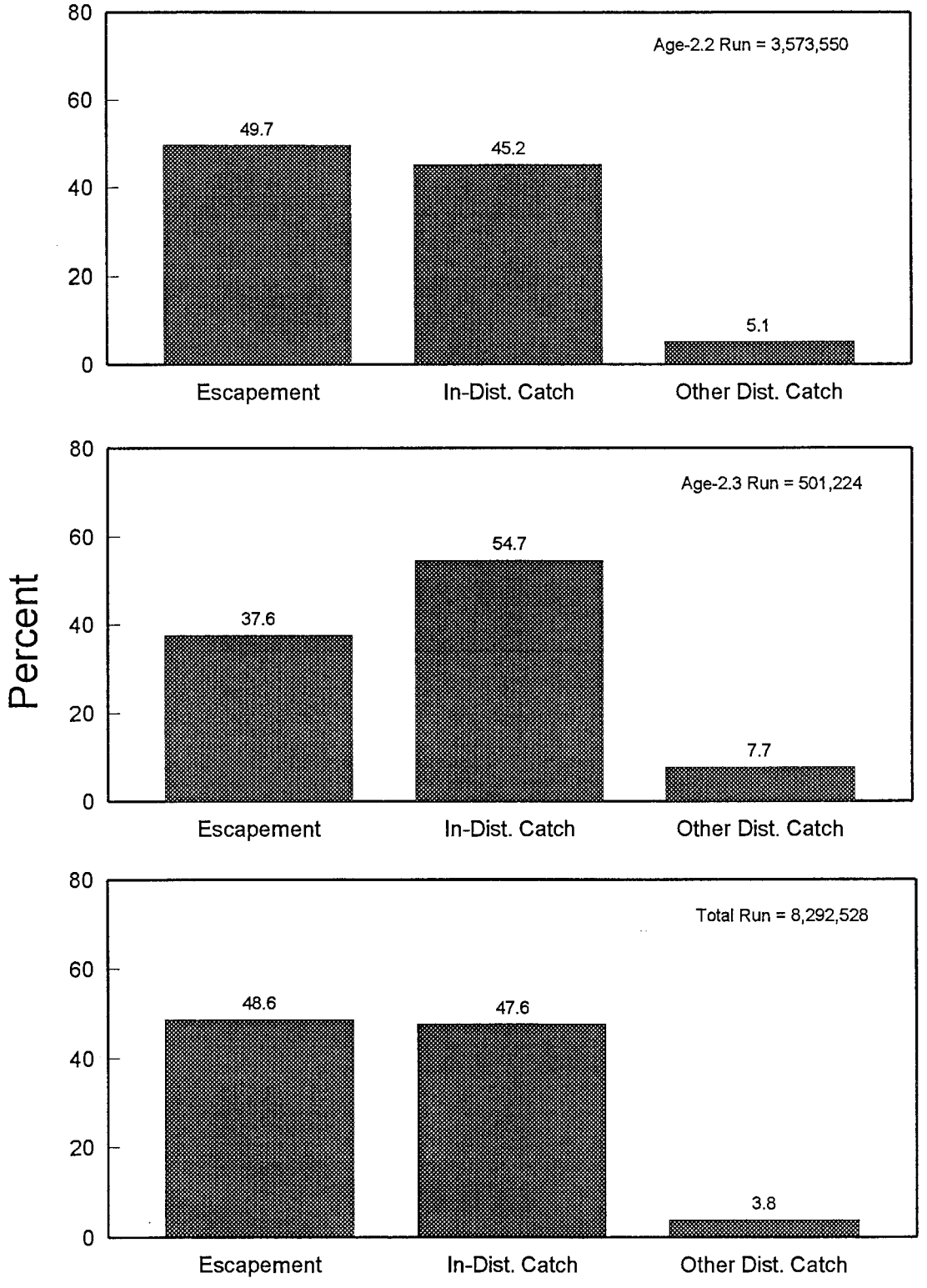

Figure 16. Estimated 1993 Kvichak River sockeye salmon run, escapement, in-district catch, and other district catch for ages 2.2 and 2.3, and all ages combined.

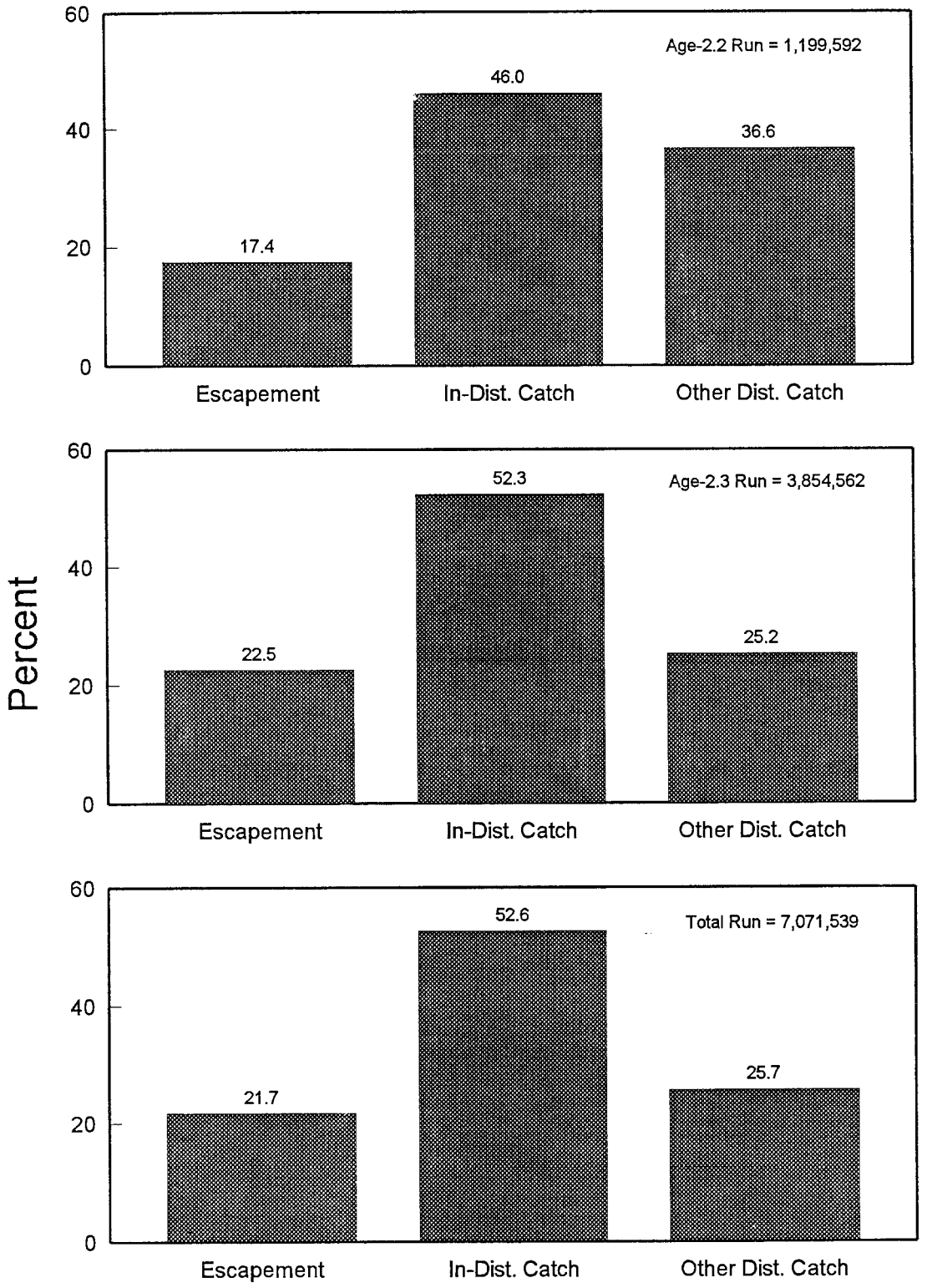

Figure 17. Estimated 1993 Naknek River sockeye salmon run, escapement, in-district catch, and other district catch for ages 2.2 and 2.3, and all ages combined.

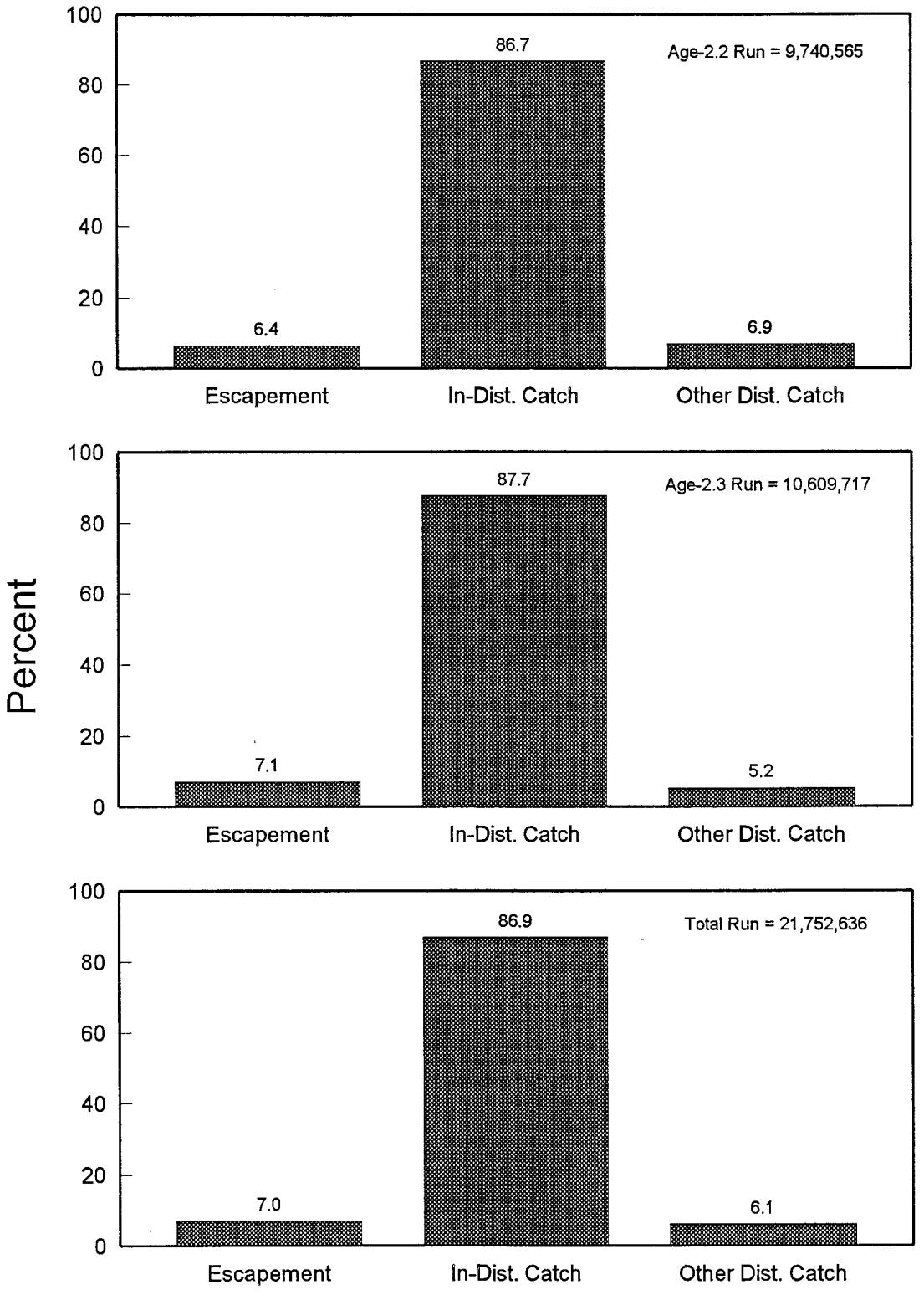

Figure 18. Estimated 1993 Egegik River sockeye salmon run, escapement, in-district catch, and other district catch for ages 2.2 and 2.3, and all ages combined.

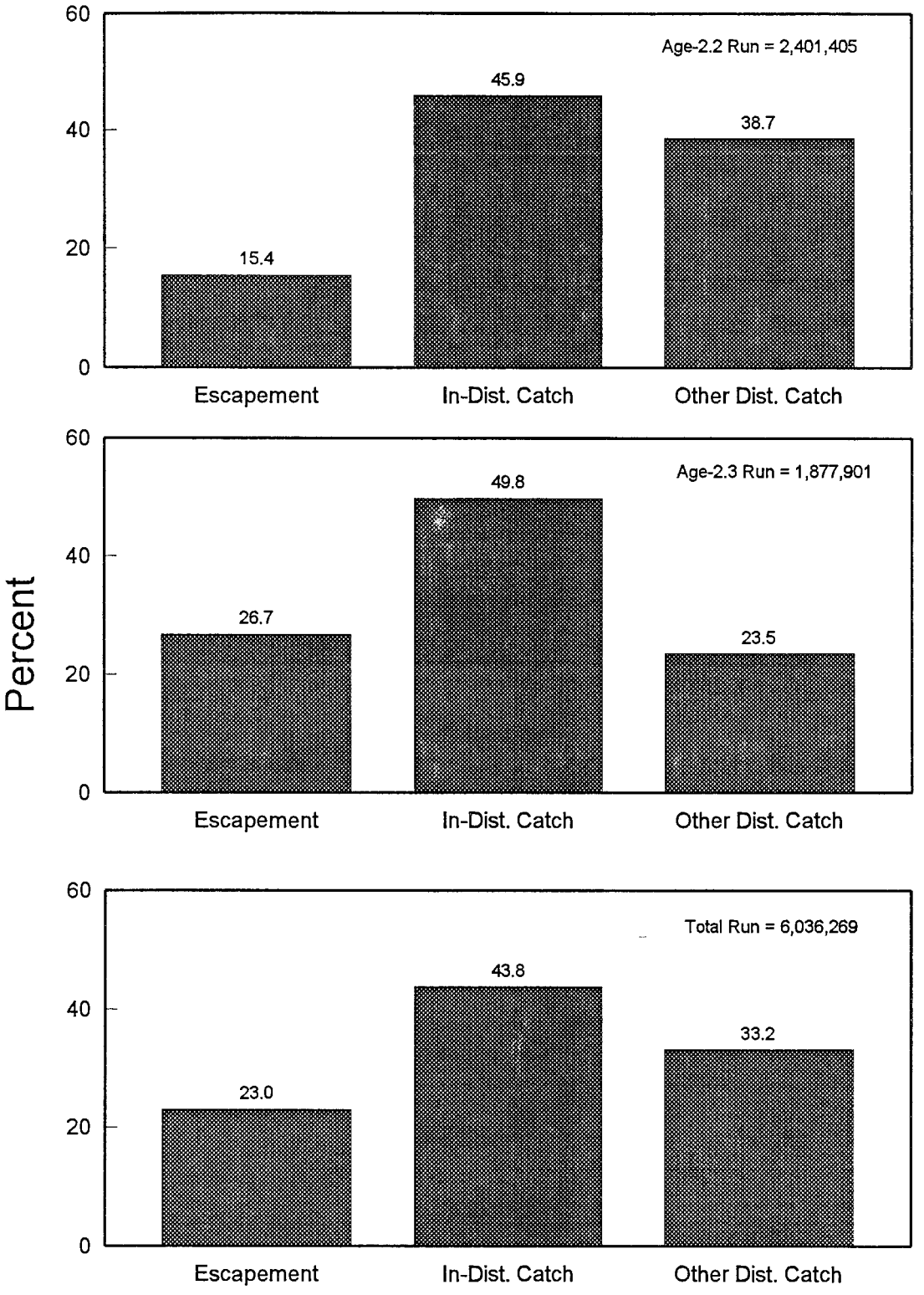

Figure 19. Estimated 1993 Ugashik River sockeye salmon run, escapement, in-district catch, and other district catch for ages 2.2 and 2.3, and all ages combined.

Appendix A.1. Scale variables screened for linear discriminant function analysis of age-2.2 and -2.3 sockeye salmon for the Eastside of Bristol Bay, 1993.

Variable Number	Variable Name	Zone
		First Freshwater Annular Zone
1	NC1FW	Number of circuli first freshwater
2	S1FW	Size (width) of first freshwater
3 (16)	CO-C2	Distance, scale focus (CO) to circulus 2 (C2)
4 (17)	CO-C4	Distance, scale focus to circulus 4
5 (18)	CO-C6	Distance, scale focus to circulus 6
6 (19)	CO-C8	Distance, scale focus to circulus 8
7 (20)	C2-C4	Distance, circulus 2 to circulus 4
8 (21)	C2-C6	Distance, circulus 2 to circulus 6
9 (22)	C2-C8	Distance, circulus 2 to circulus 8
10 (23)	C4-C6	Distance, circulus 4 to circulus 6
11 (24)	C4-C8	Distance, circulus 4 to circulus 8
12 (25)	C(NC-4)-E1FW	Distance, circulus (number circuli first freshwater minus 2) to end first freshwater
13 (26)	C(NC-2)-E1FW	Distance, circulus (number circuli first freshwater minus 4) to end first freshwater
14	C2-E1FW	Distance, circulus 2 to end first freshwater
15	C4-E1FW	Distance, circulus 4 to end first freshwater
16 thru	CO-C2/S1FW ...	Relative widths, (variables 3-13)/S1FW
26	C(NC-2)-E1FW/S1FW	
27	S1FW/NC1FW	Average interval between circuli in first freshwater
28	NC 1ST 3/4	Number of circuli in first 3/4 of first freshwater
29	MAX DIST	Maximum distance between 2 consecutive circuli in first freshwater
30	MAX DIST/S1FW	Relative width, (variable 29)/S1FW
		Second Freshwater Annular Zone
31	NC2FW	Number of circuli second freshwater
32	S2FW	Size (width) of second freshwater
33 (46)	E1FW-C2	Distance, end of first freshwater to circulus 2 (C2) in second freshwater
34 (47)	E1FW-C4	Distance, end of first freshwater to circulus 4
35 (48)	E1FW-C6	Distance, end of first freshwater to circulus 6
36 (49)	E1FW-C8	Distance, end of first freshwater to circulus 8
37 (50)	C2-C4	Distance, circulus 2 to circulus 4
38 (51)	C2-C6	Distance, circulus 2 to circulus 6
39 (52)	C2-C8	Distance, circulus 2 to circulus 8
40 (53)	C4-C6	Distance, circulus 4 to circulus 6
41 (54)	C4-C8	Distance, circulus 4 to circulus 8
42 (55)	C(NC-4)-E2FW	Distance, circulus (number circuli second freshwater minus 4) to end second freshwater
43 (56)	C(NC-2)-E2FW	Distance, circulus (number circuli second freshwater minus 2) to end second freshwater
44	C2-E2FW	Distance, circulus 2 to end second freshwater
45	C4-E2FW	Distance, circulus 4 to end second freshwater
46 thru	E1FW-C2/S2FW ...	Relative widths, (variables 33-43)/S2FW
56	C(NC-2)-E2FW/S2FW	
57	S2FW/NC2FW	Average interval between circuli in second freshwater
58	NC 1ST 3/4	Number of circuli in first 3/4 of second freshwater
59	MAX DIST	Maximum distance between 2 consecutive circuli in second freshwater
60	MAX DIST/S2FW	Relative width, (variable 59)/S2FW

-Continued-

Appendix A.1. (p 2 of 2).

Variable Number	Variable Name	Zone
		Plus Growth Zone
61	NCPG	Number of circuli in plus growth
62	SPGZ	Size (width) plus growth zone
		Freshwater and Plus Growth Zones
63	NC1FW + NC2FW	Total number of circuli first and second freshwater
64	S1FW + S2FW	Total size (width) of first and second freshwater
65	NC1FW+NC2FW+NCPG	Total number of circuli first and second freshwater and plus growth
66	S1FW+S2FW+SPGZ	Total size (width) first and second freshwater and plus growth
67	S1FW/S1FW+S2FW+SPGZ	Relative width, (variable 2)/S1FW+S2FW+SPGZ
68	SPGZ/S1FW+S2FW+SPGZ	Relative width, (variable 62)/S1FW+S2FW+SPGZ
69	S2FW/S1FW+S2FW+SPGZ	Relative width, (variable 32)/S1FW+S2FW+SPGZ
		First Marine Annular Zone
70	NC1OZ	Number of circuli in first ocean zone
71	S1OZ	Size (width) first ocean zone
72 (90)	EFW-C3	Distance, end of freshwater growth to circulus 3
73 (91)	EFW-C6	Distance, end of freshwater growth to circulus 6
74 (92)	EFW-C9	Distance, end of freshwater growth to circulus 9
75 (93)	EFW-C12	Distance, end of freshwater growth to circulus 12
76 (94)	EFW-C15	Distance, end of freshwater growth to circulus 15
77 (95)	C3-C6	Distance, circulus 3 to circulus 6
78 (96)	C3-C9	Distance, circulus 3 to circulus 9
79 (97)	C3-C12	Distance, circulus 3 to circulus 12
80 (98)	C3-C15	Distance, circulus 3 to circulus 15
81 (99)	C6-C9	Distance, circulus 6 to circulus 9
82 (100)	C6-C12	Distance, circulus 6 to circulus 12
83 (101)	C6-C15	Distance, circulus 6 to circulus 15
84 (102)	C9-C15	Distance, circulus 9 to circulus 15
85 (103)	C(NC-6)-E1OZ	Distance, circulus (number circuli first ocean minus 6) to end first ocean
86 (104)	C(NC-3)-E13OZ	Distance, circulus (number circuli first ocean minus 3) to end first ocean
87	C3-E1OZ	Distance, circulus 3 to end of first ocean
88	C9-E1OZ	Distance, circulus 9 to end of first ocean
89	C15-E1OZ	Distance, circulus 15 to end of first ocean
90 thru	EFW-C3/S1OZ ...	Relative widths, (variables 72-86)/S1OZ
104	C(NC-3)-E13OZ/S1OZ	
105	S1OZ/NC1OZ	Average interval between circuli in first ocean
106	NC 1ST 1/2	Number of circuli in first 1/2 of first ocean
107	MAX DIST	Maximum distance between 2 consecutive circuli in first ocean
108	MAX DIST/S1OZ	Relative width, (variable 107)/S1OZ
		Second Marine Annular Zone
109	S2OZ	Size (width) of second ocean zone